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Matsuno et al.

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(45) Date of Patent: May 2, 2006

(54) **TEMPERATURE SENSOR, HEAT FIXING DEVICE, AND IMAGE FORMING DEVICE**

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G03G 15/00 (2006.01)
G03G 15/20 (2006.01)

(52) **U.S. Cl.** **399/69**; 399/44

(58) **Field of Classification Search** 399/44, 399/67, 69, 33, 320, 328, 335; 374/100, 374/153

See application file for complete search history.

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(57) **ABSTRACT**

A temperature sensor for detecting the temperature of a heating roller contacts the heating roller with the bottom surface of a contact section provided on the front end of the temperature sensor. A temperature detecting element is disposed on the upper surface of the front end at a position corresponding to the contact section. The front edge of the sensor is bent away from the heating roller. During a printing process, a portion of the toner that is liquefied in the heat fixing process remains on the heating roller and is subsequently deposited on the bottom surface of the contact plate as the heating roller rotates. However, by forming the surface from the contact section to the front edge as a smooth curved surface to eliminate edges or corners that can lead to the accumulation of toner, a clump of toner does not form on the bottom surface of the contact plate.

26 Claims, 15 Drawing Sheets

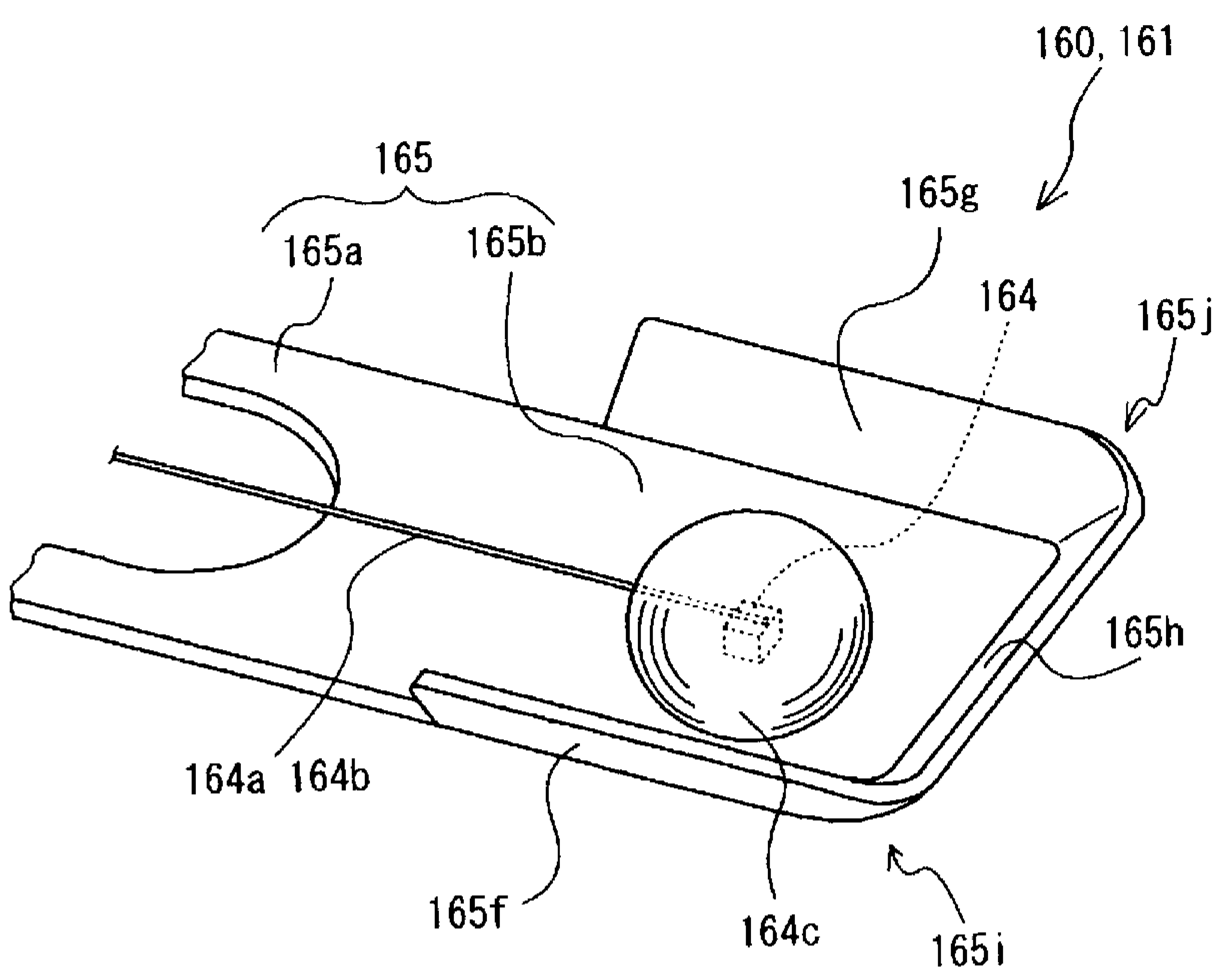


FIG.1
RELATED ART

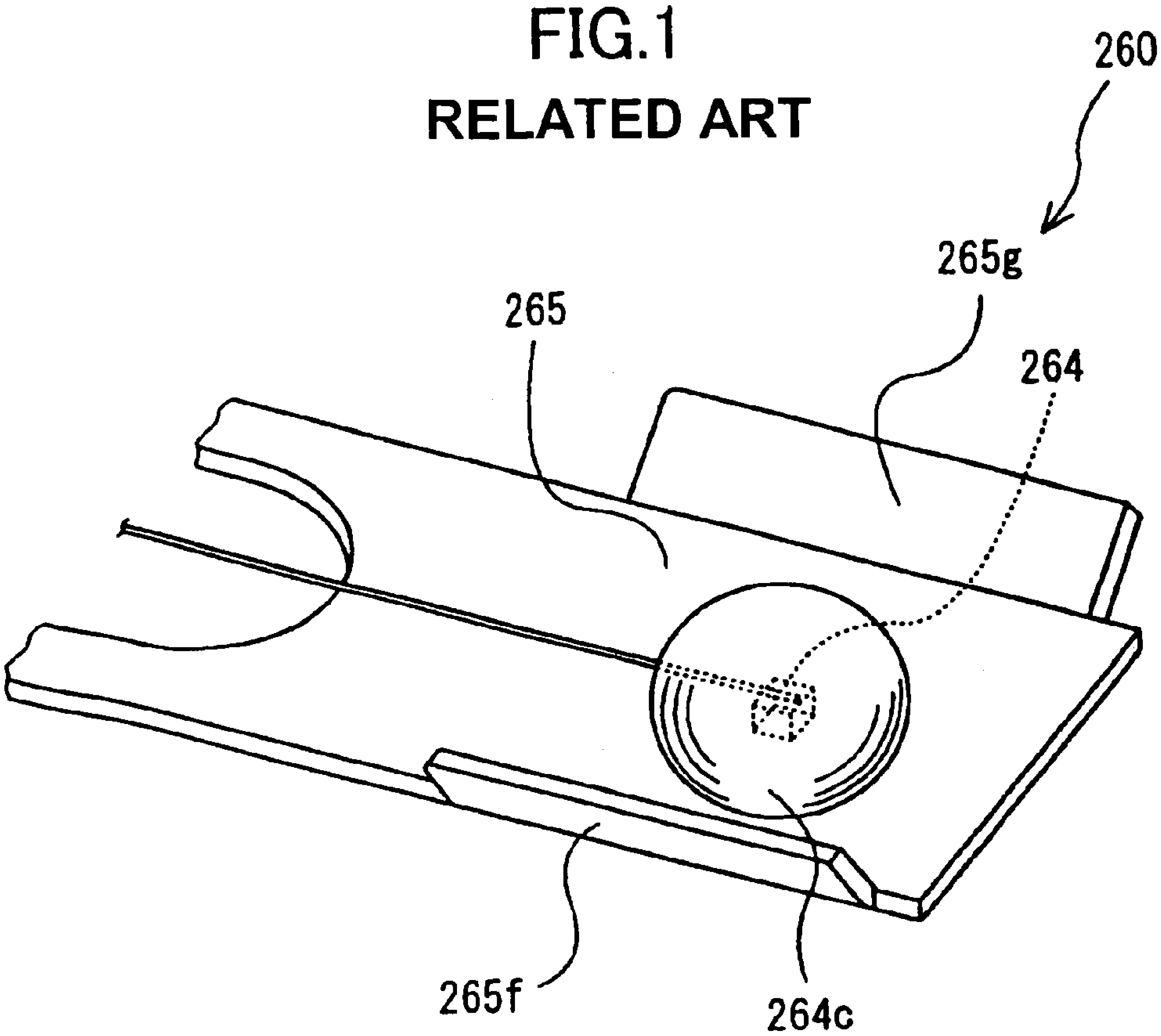


FIG.2
RELATED ART

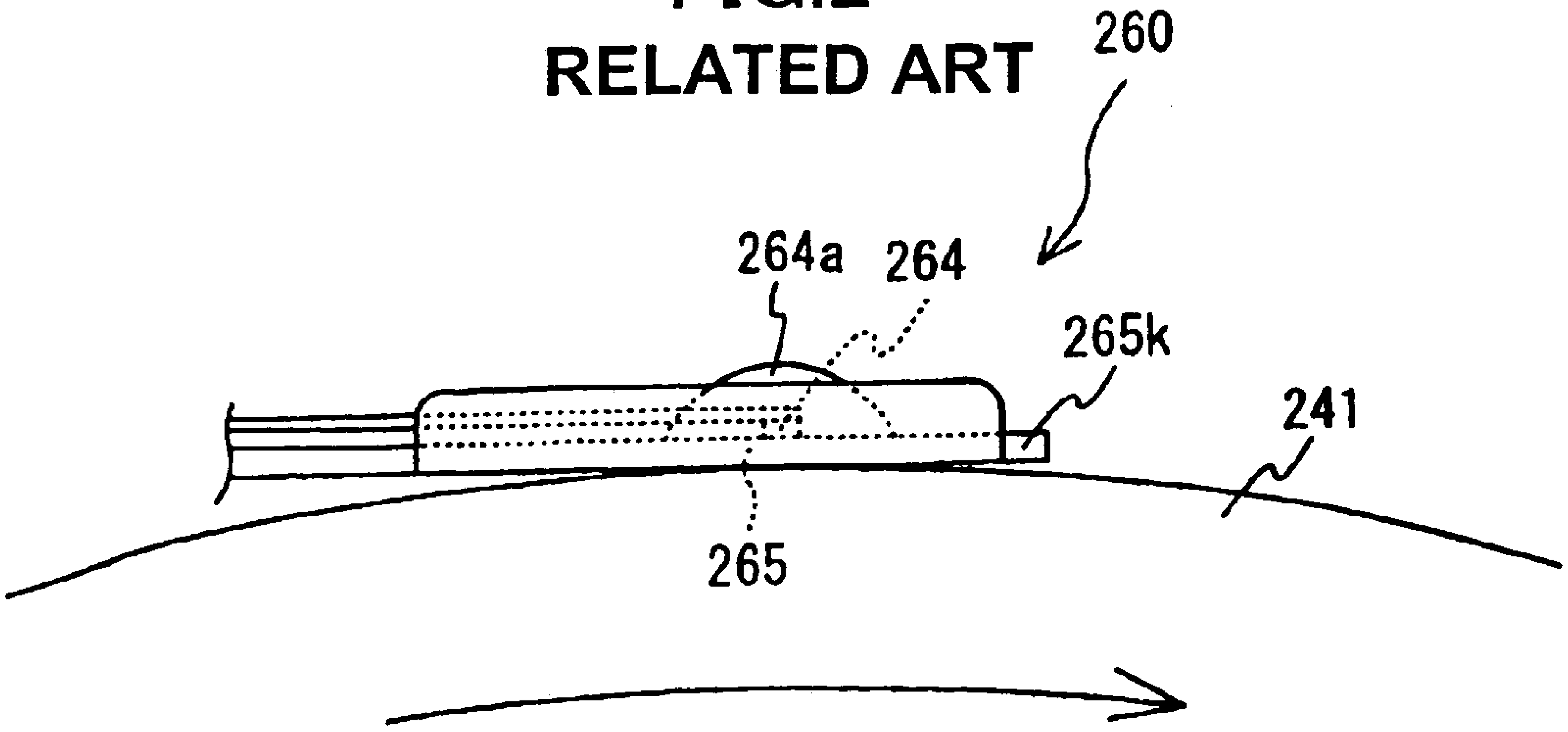


FIG.3

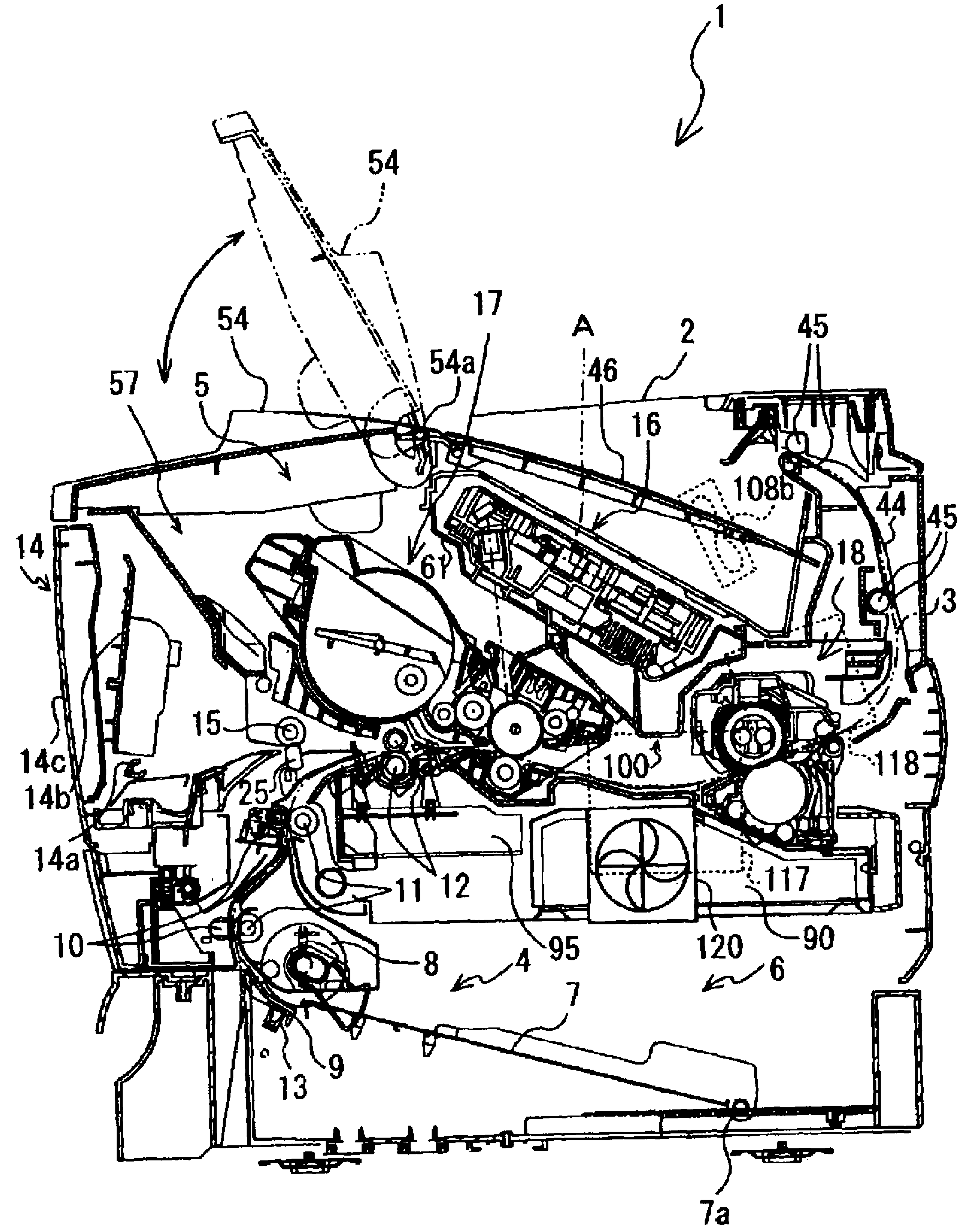
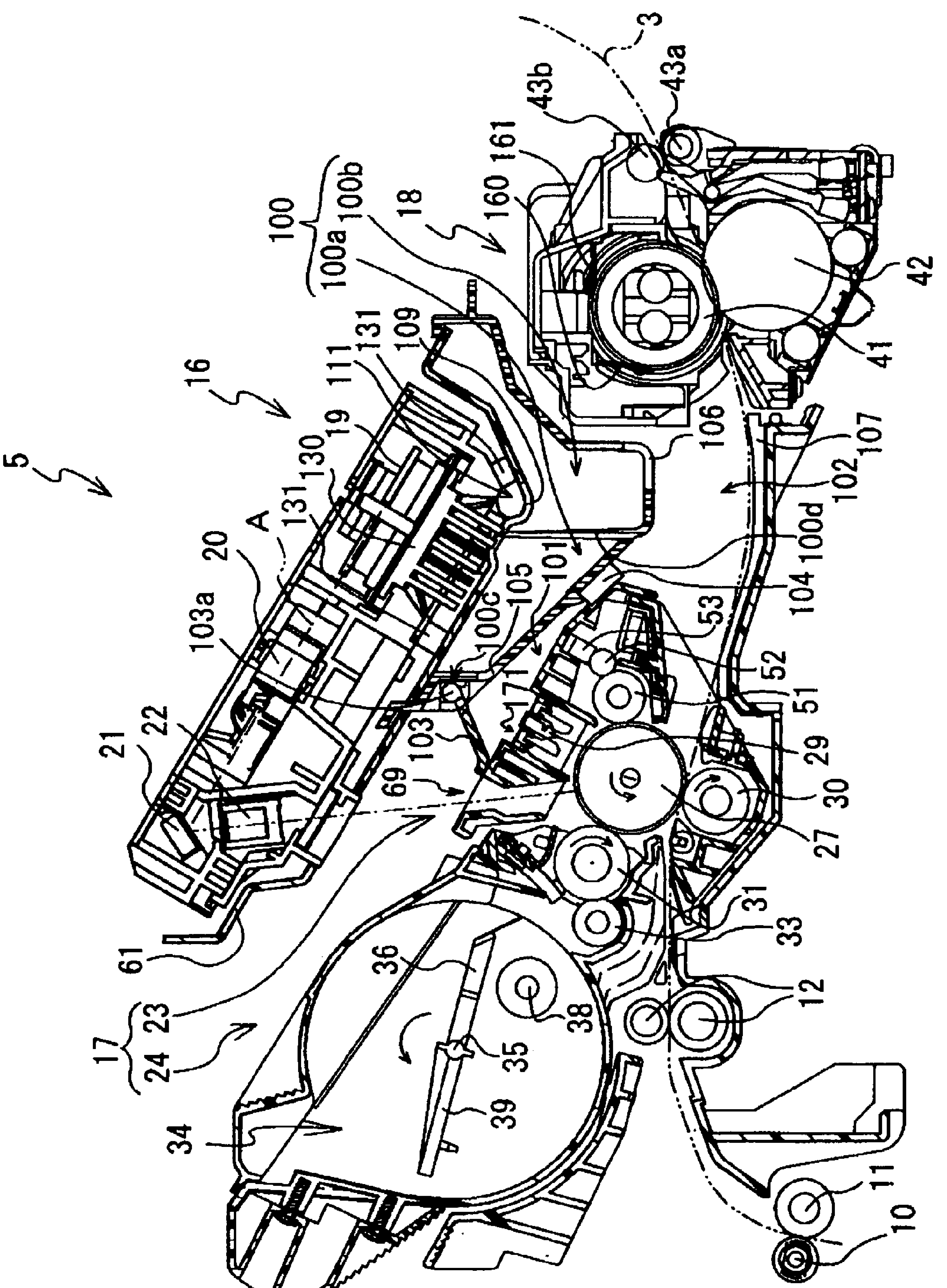

1
54
54
17
A
2
45
57
5
54a
46
16
108b
44
45
14
61
18
3
15
14c
100
118
14b
25
12
117
14a
11
10
95
120
90
8
4
6
7
13
9
7a

FIG.4



5
3
43a
43b
161
160
18
100
100a
100b
16
109
111
131
19
130
131
A
20
103a
21
22
61
23
17
24
34
35
36
38
39
69
103
100c
105
101
71
104
100d
106
107
102
41
42
53
52
51
29
30
27
31
33
12
11
10

FIG.5

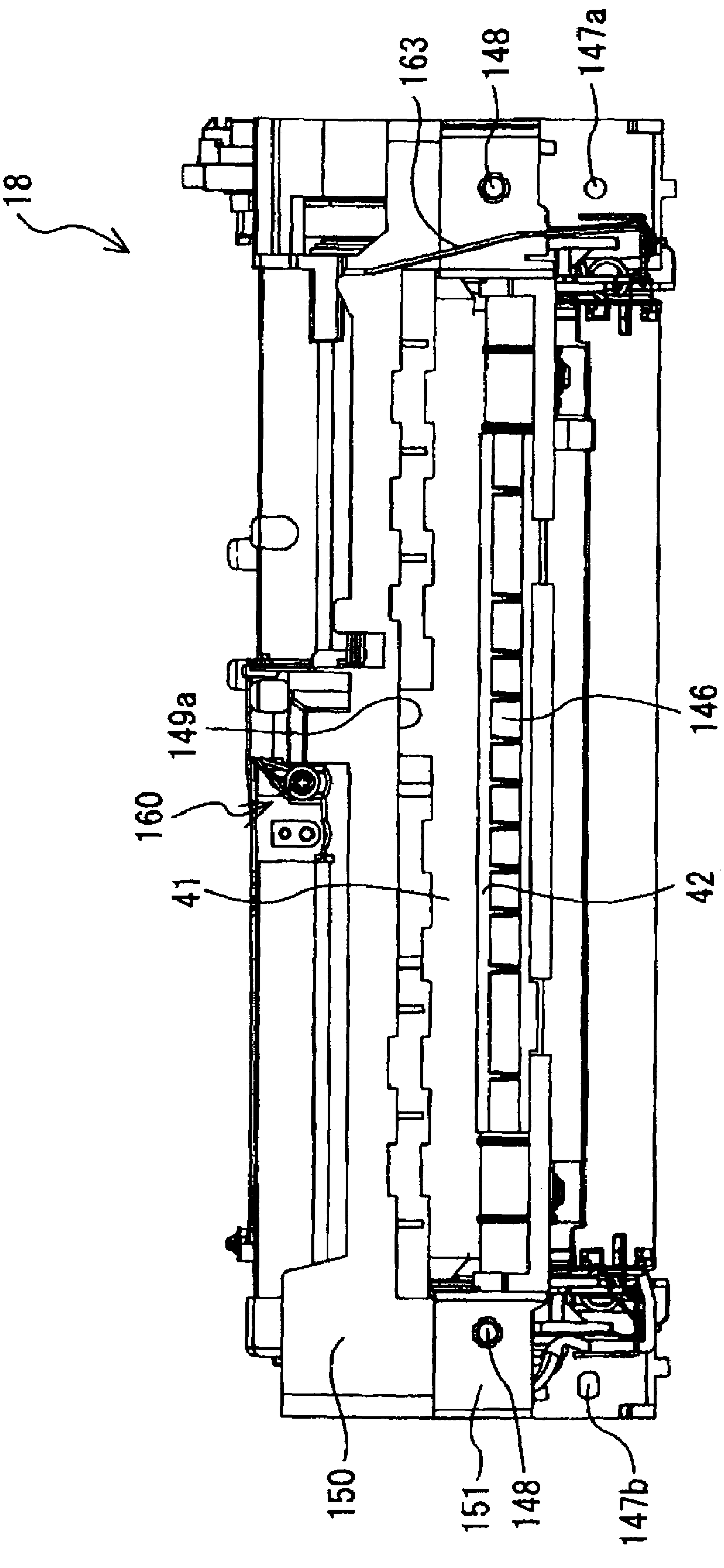


FIG.6

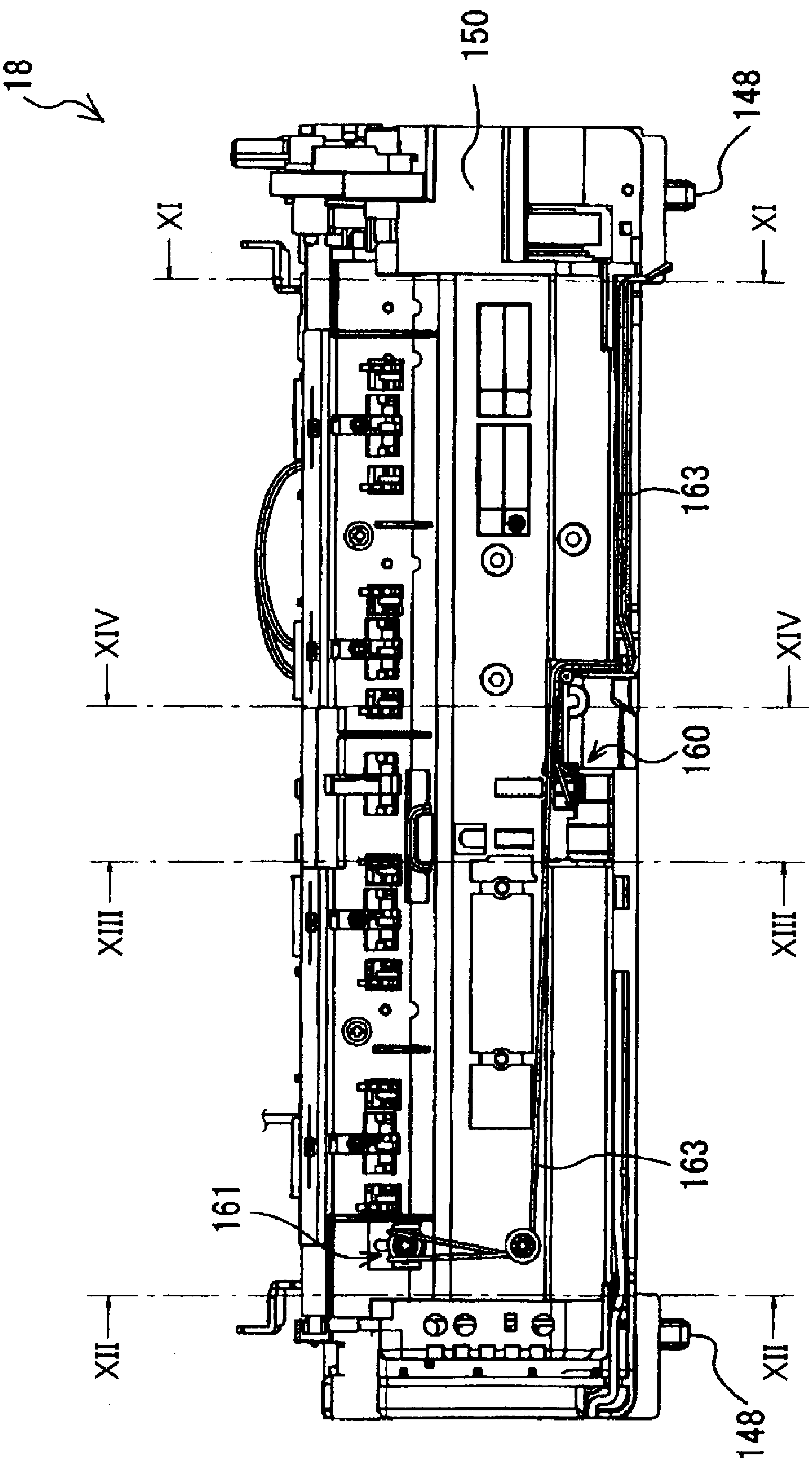


FIG.7

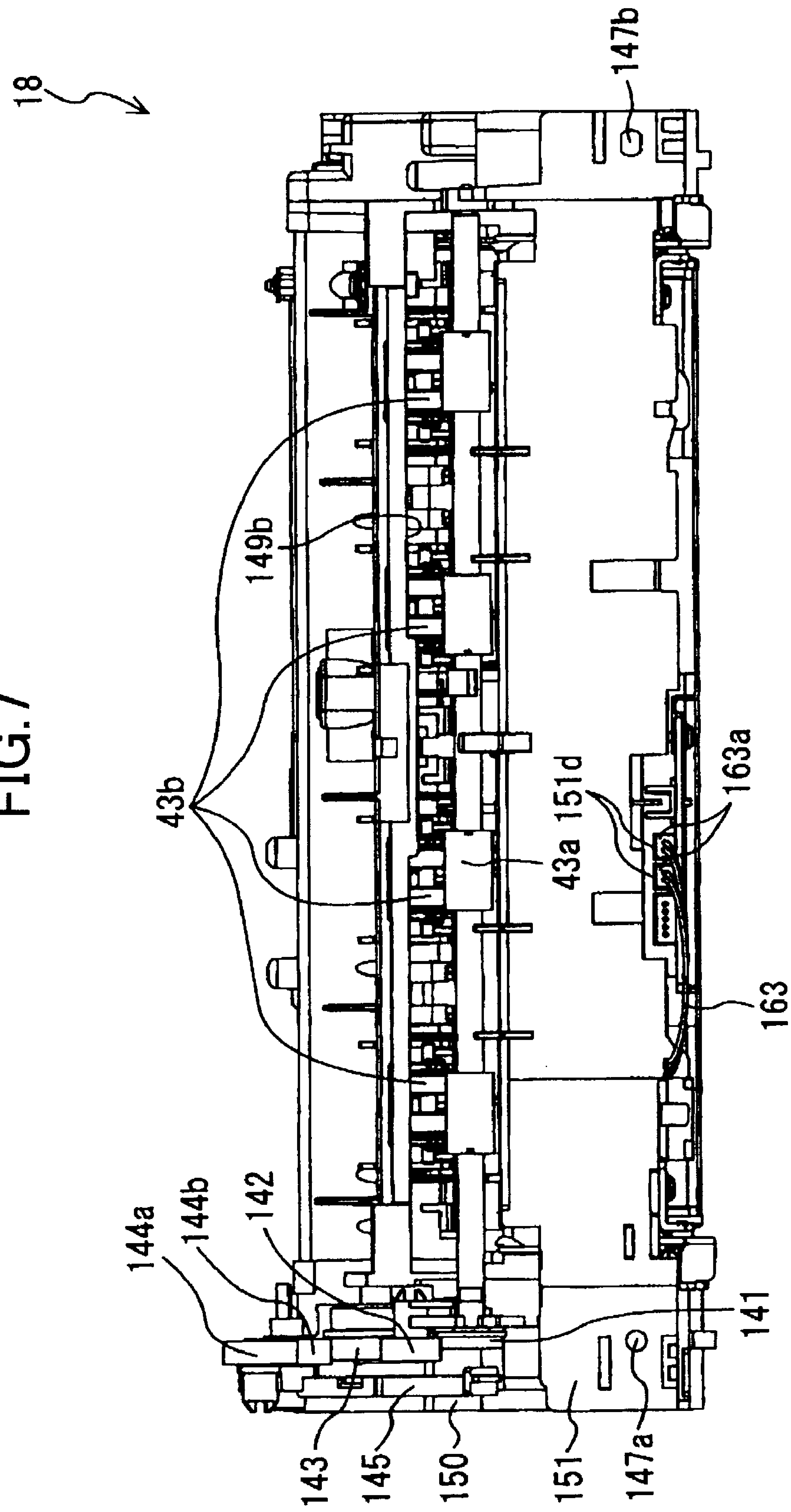

18
147b
149b
43b
43a
151d
163a
163
144a
144b
142
141
143
145
150
151
147a

FIG.8

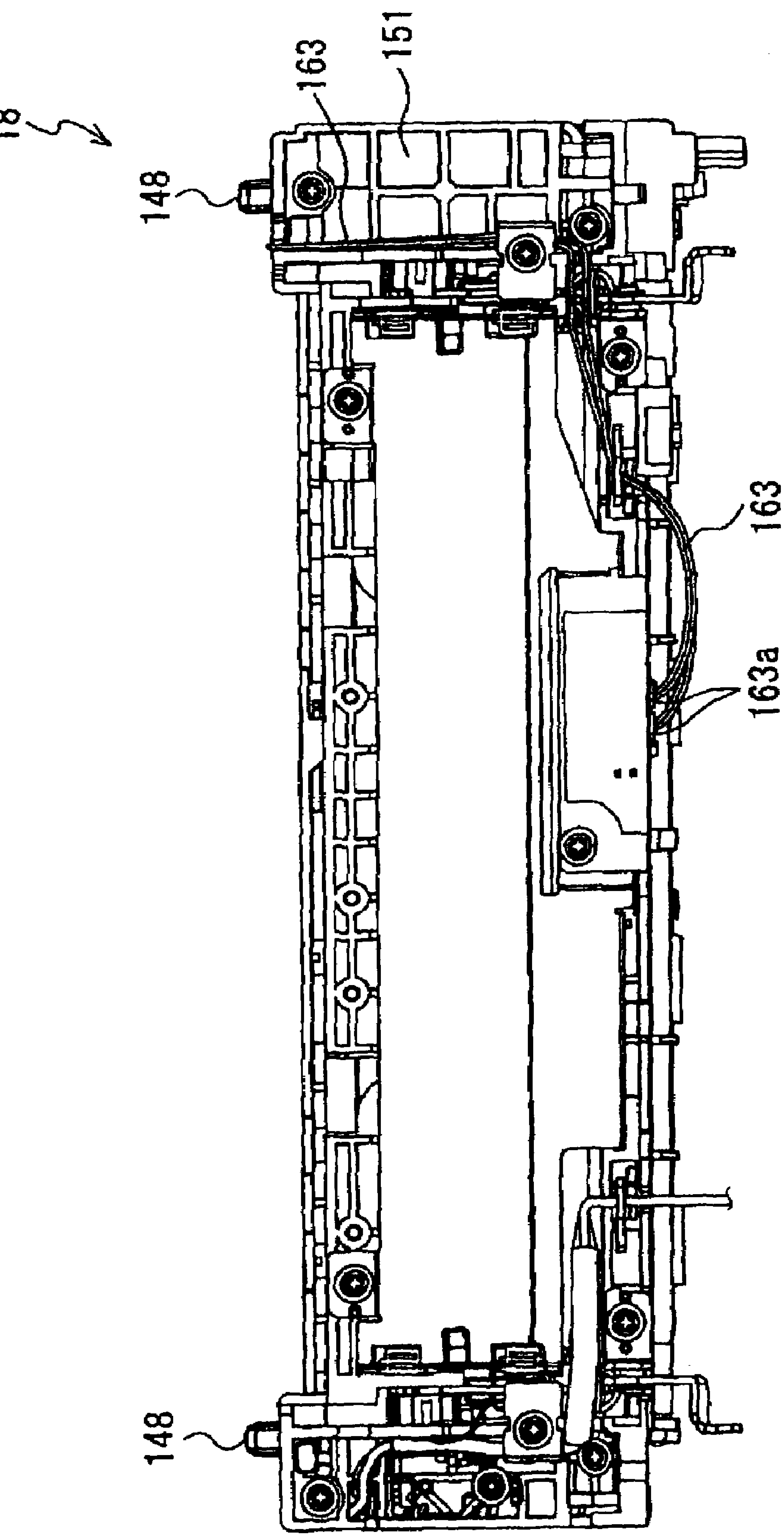
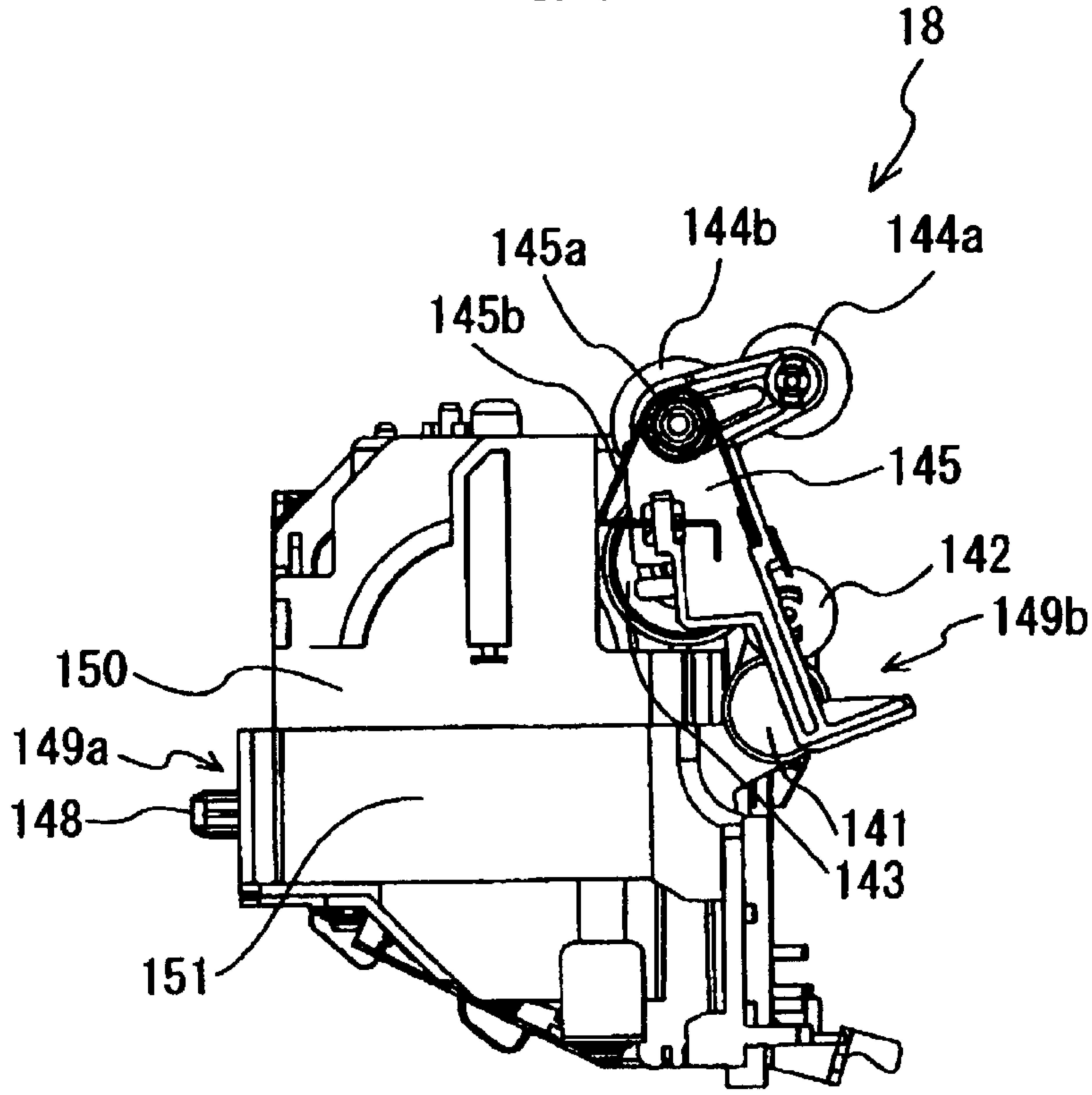


FIG.9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145a
144b
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145b
145
142
149b
150
149a
148
141
143
151

FIG.10

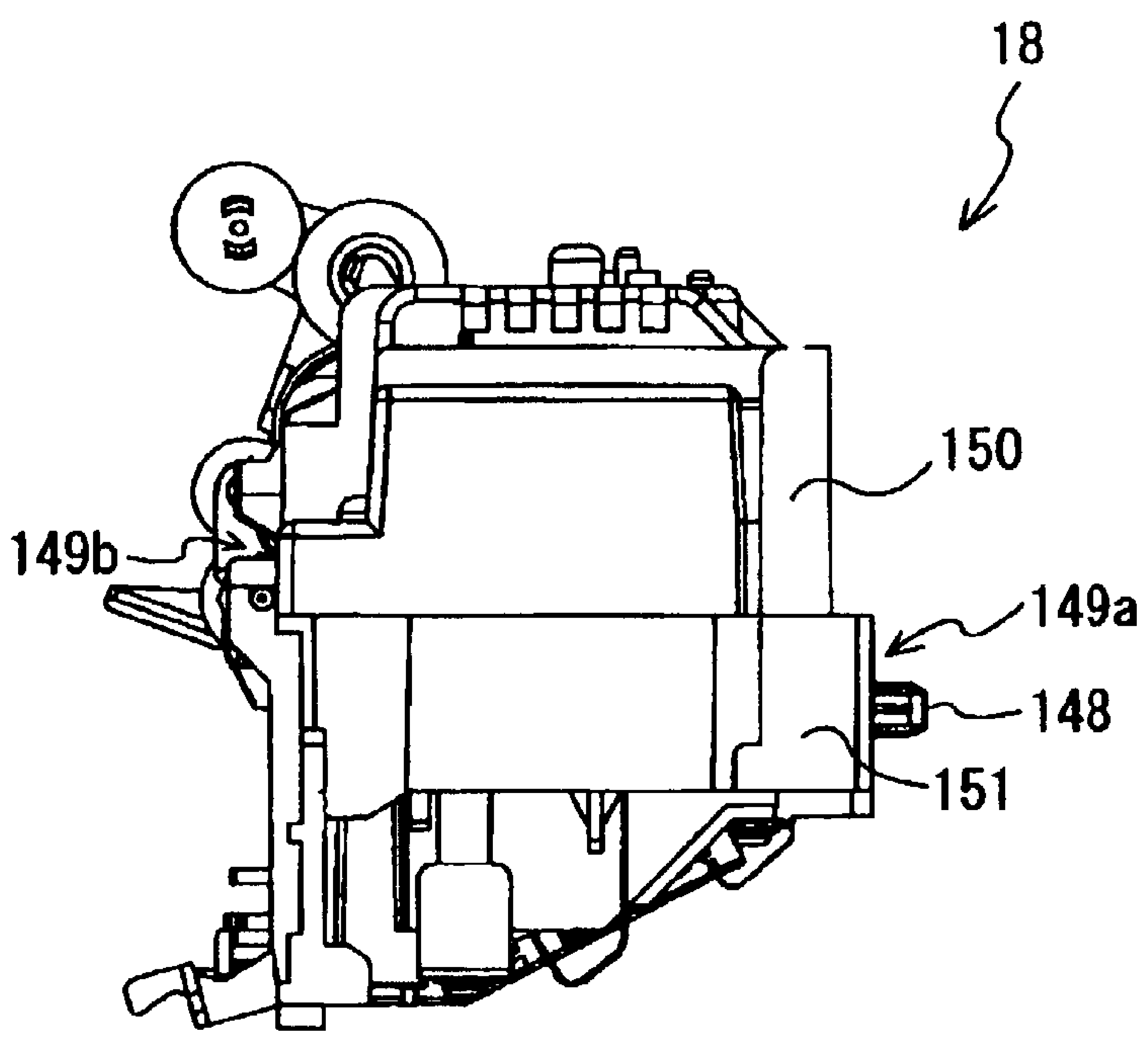
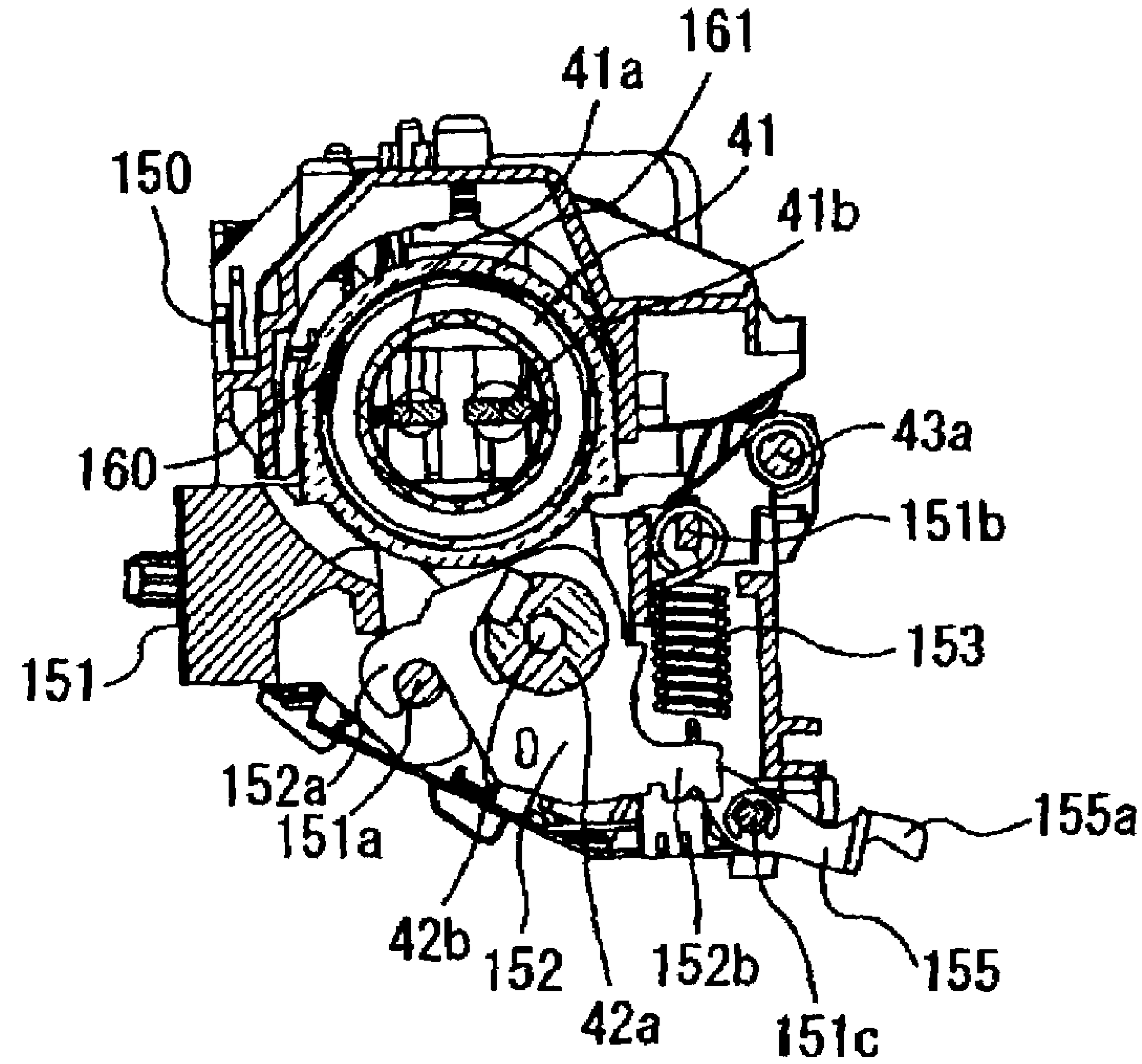

18
150
149b
149a
148
151

FIG.11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41a
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41b
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43a
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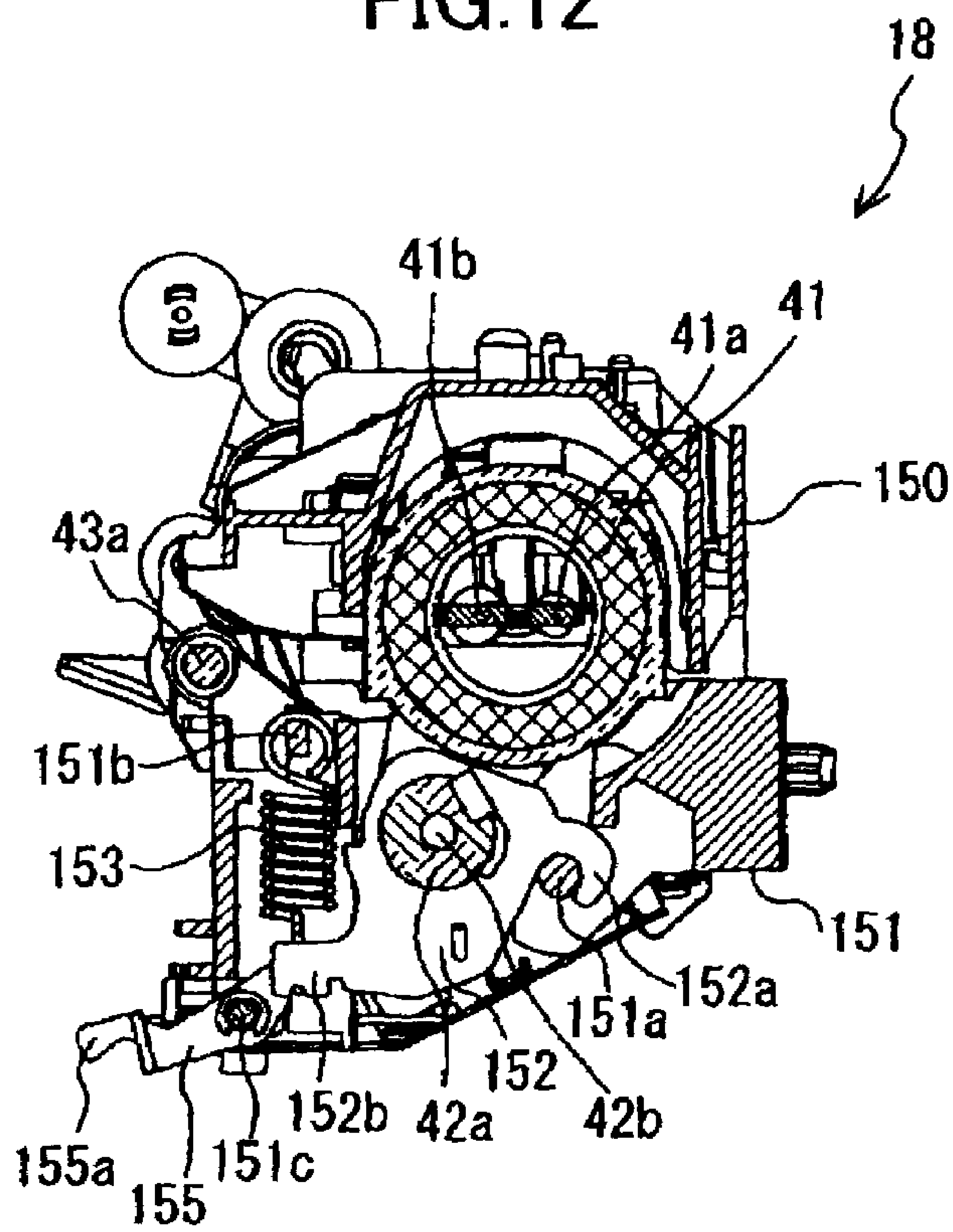
152a
151a
155a
42b
152
152b
155
42a
151c

FIG.12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41b
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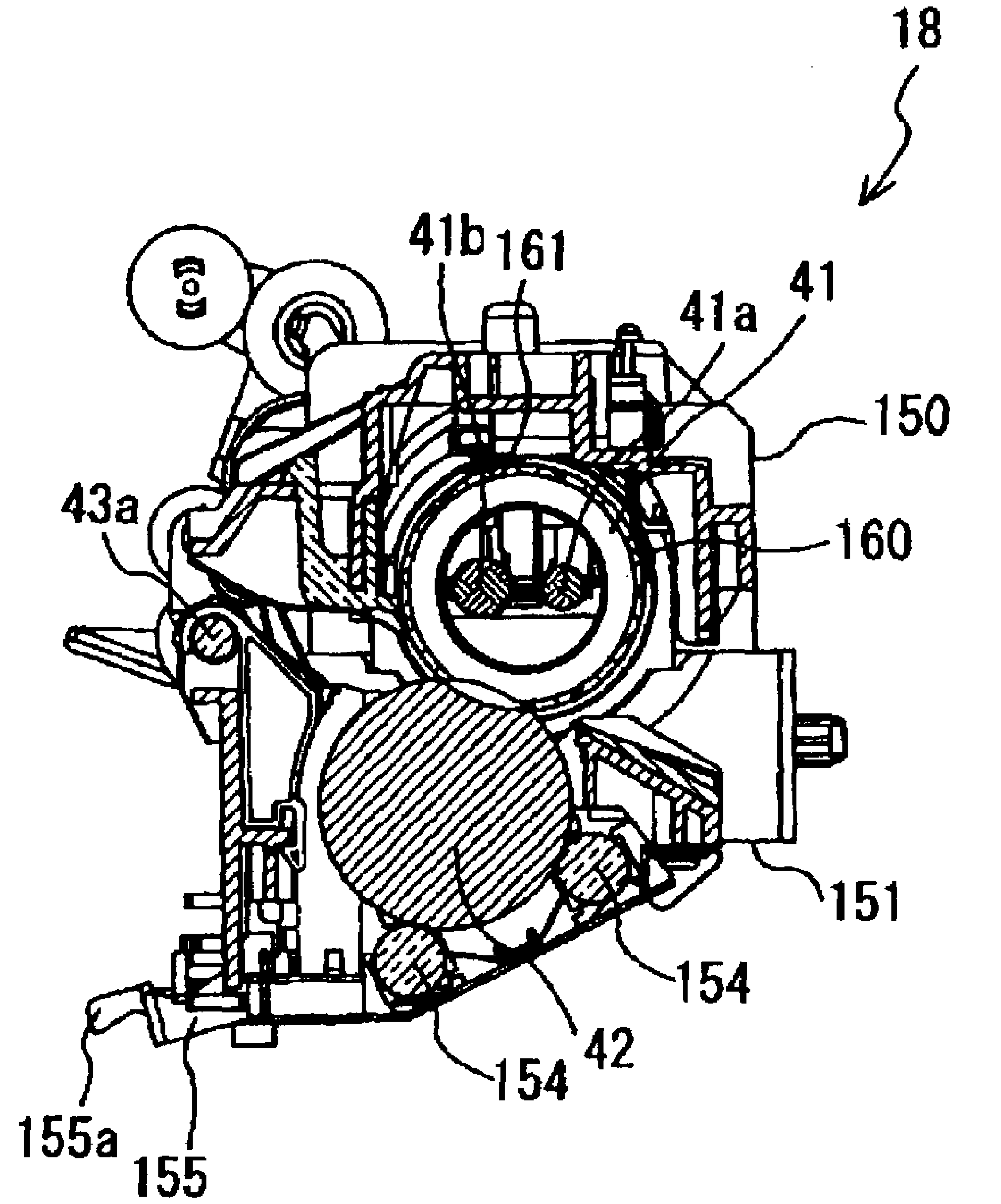
152a
151a
152
42b
152b
42a
155a
151c
155

FIG.13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41b
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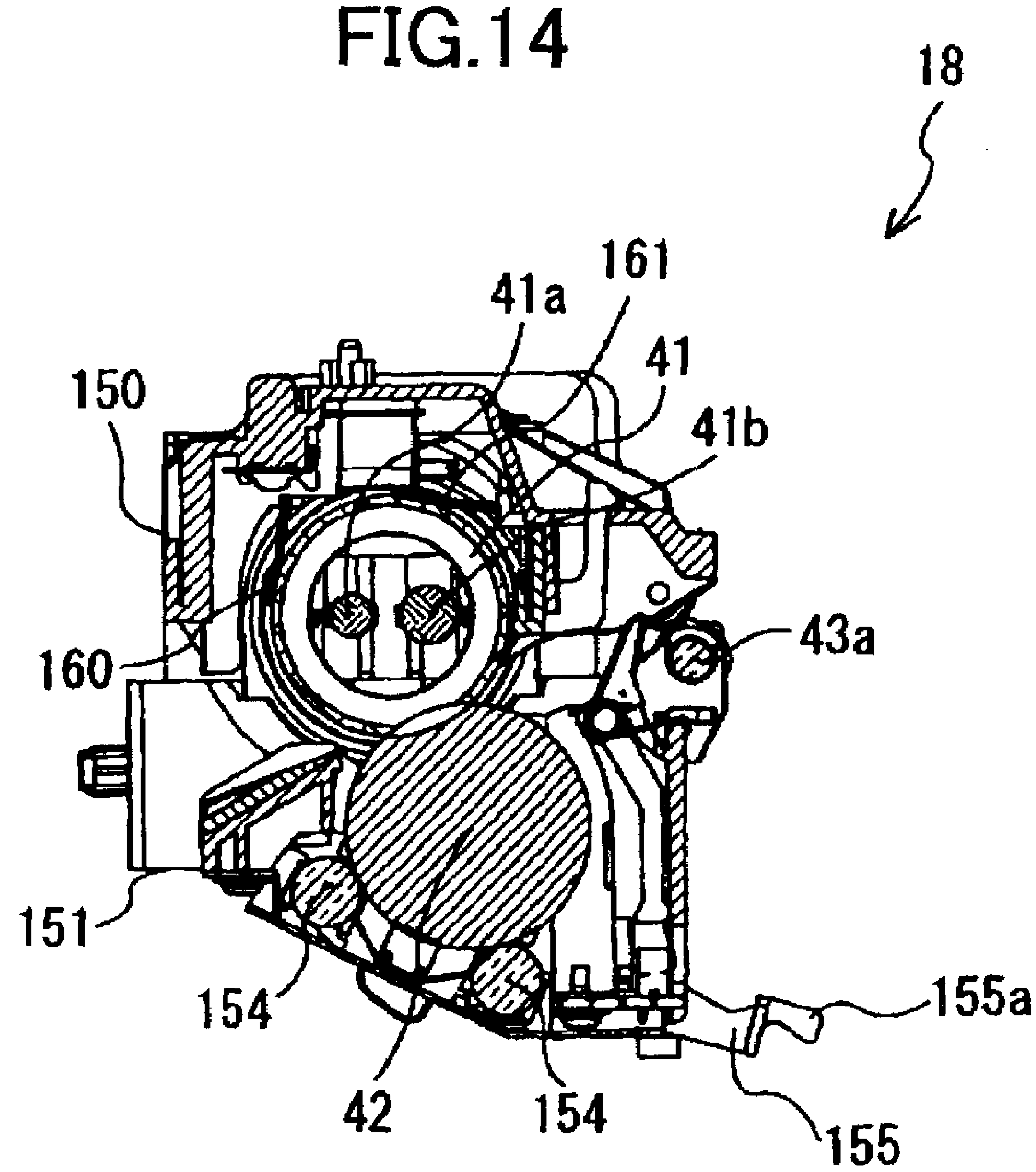
43a
160
151
154
42
154
155a
155

FIG.14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43a
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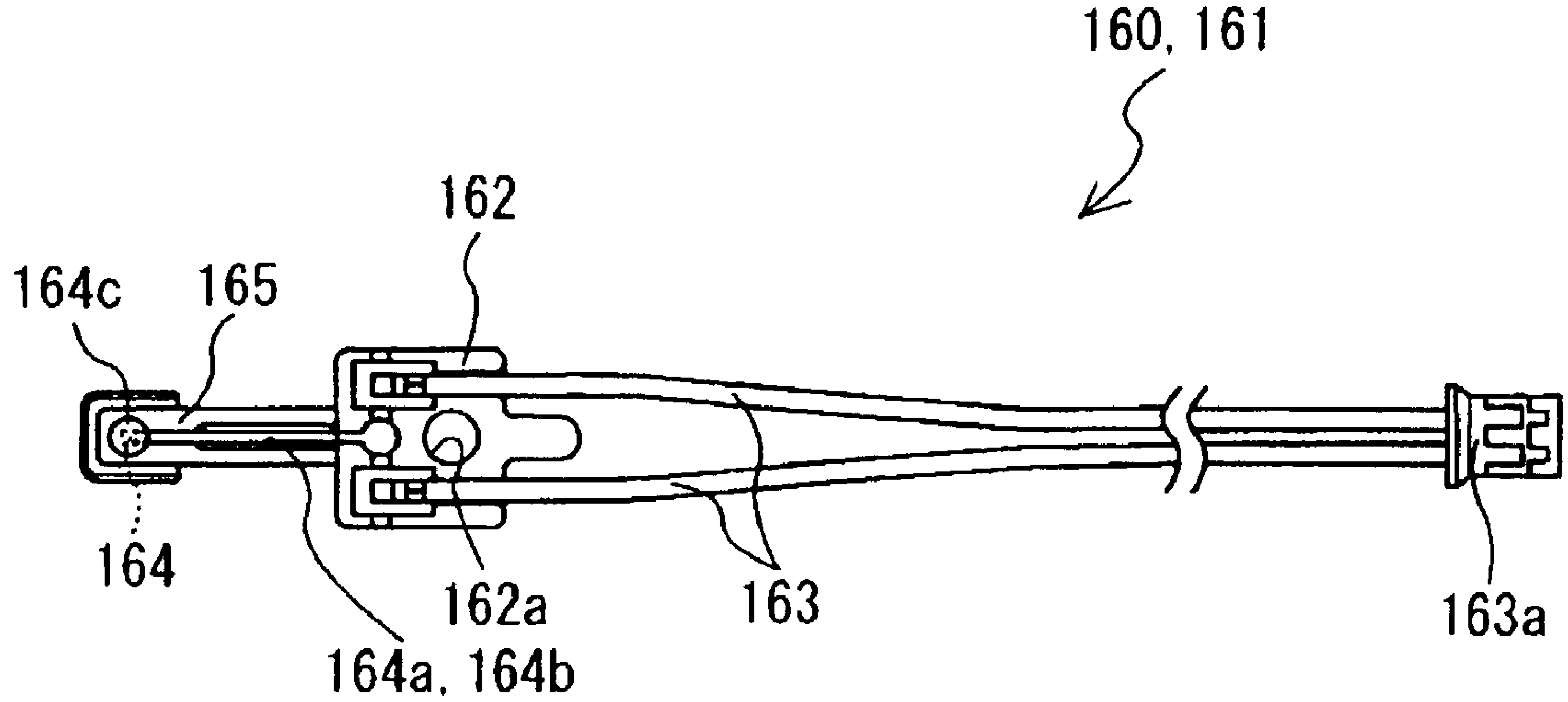
151
154
155a
42
154
155

FIG.15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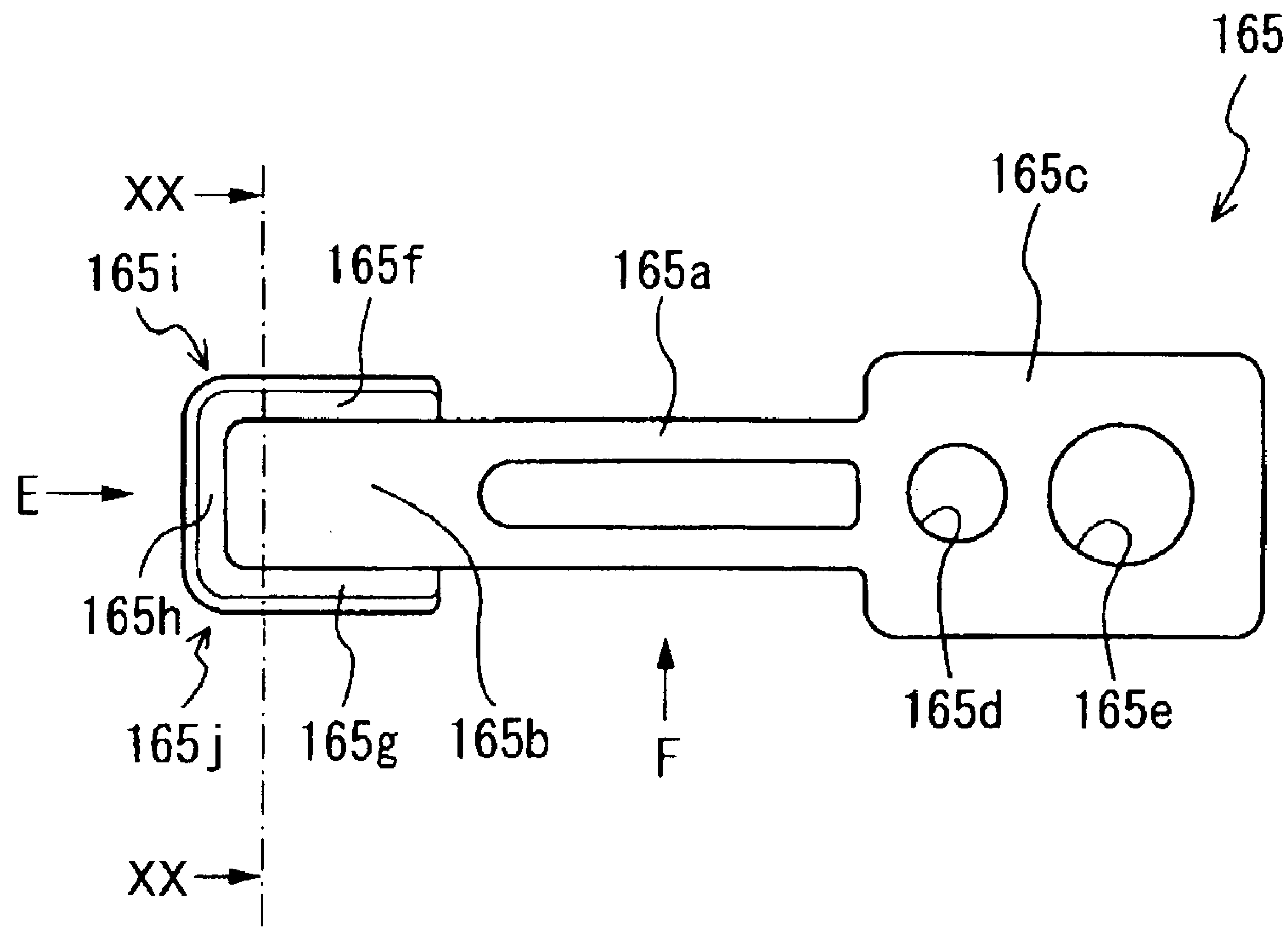
164c
165
164
162a
163
163a
164a, 164b

FIG.16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165f
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E
165h
165j
165g
165b
F
165d
165e
XX

FIG.17

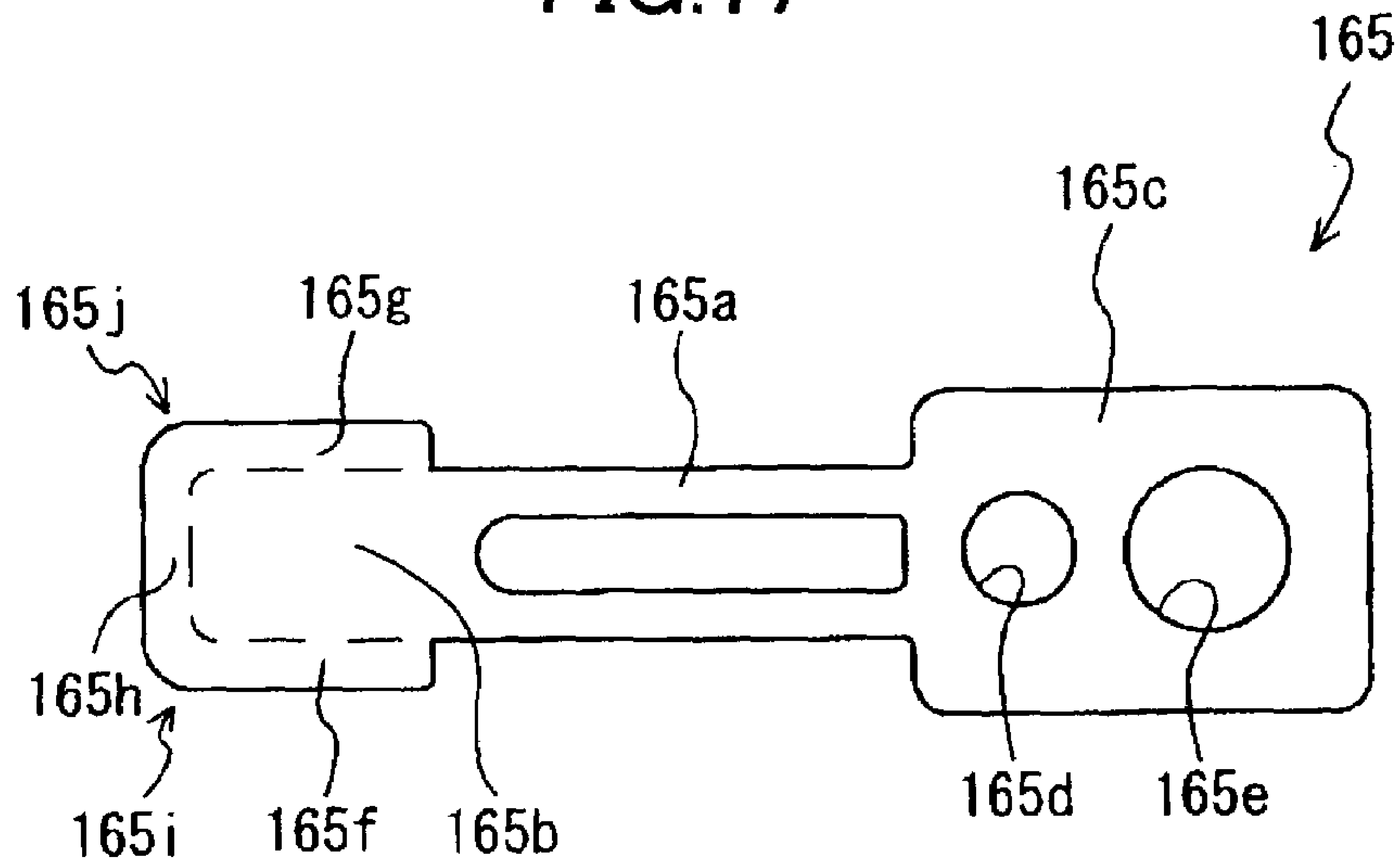


FIG.18

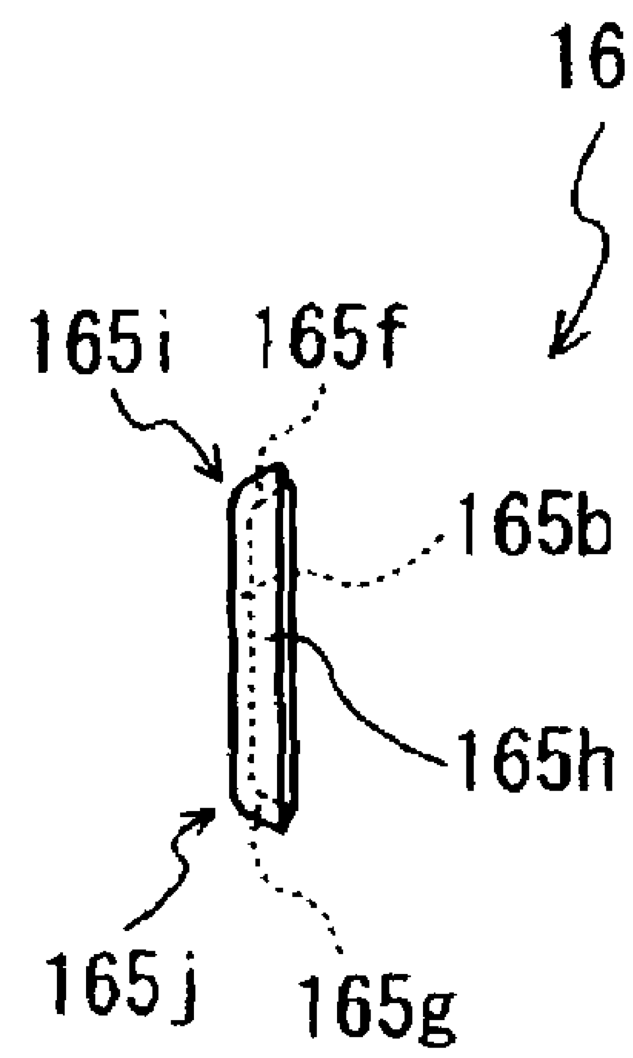


FIG.19

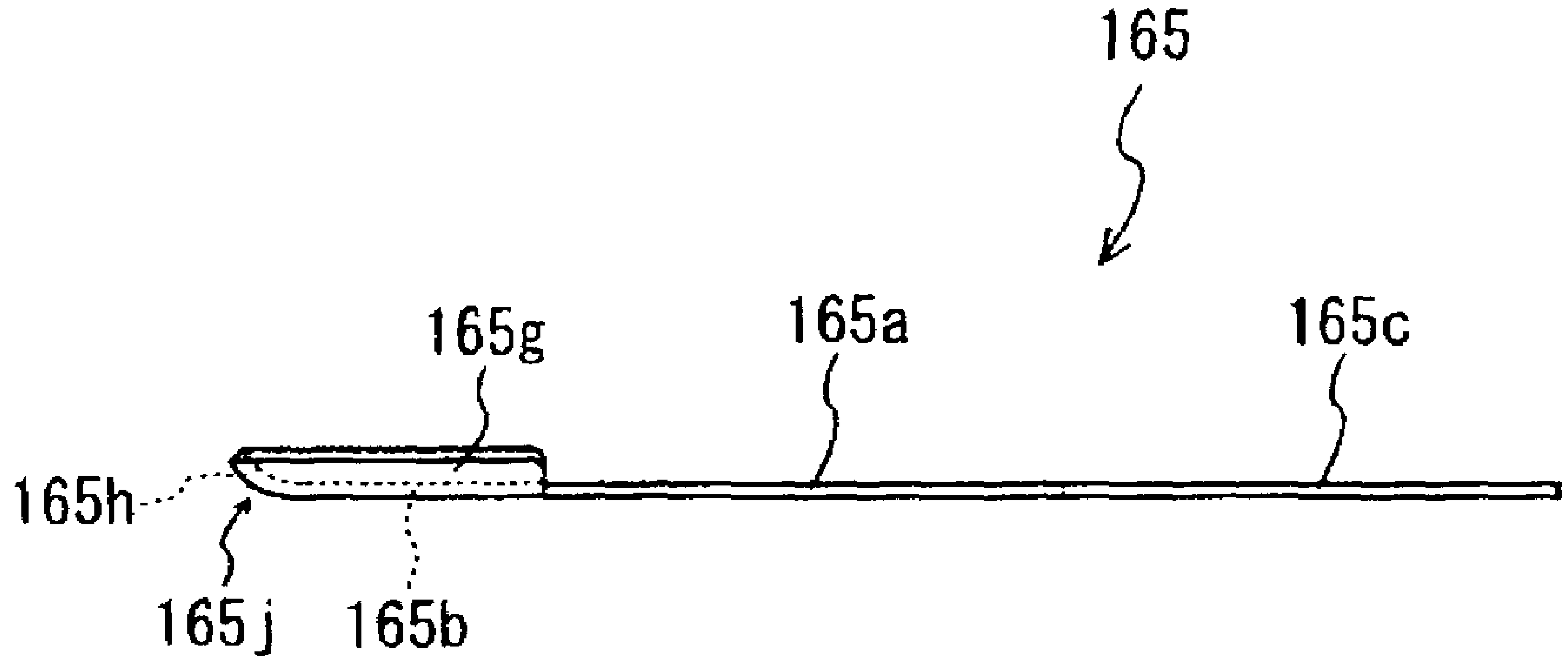
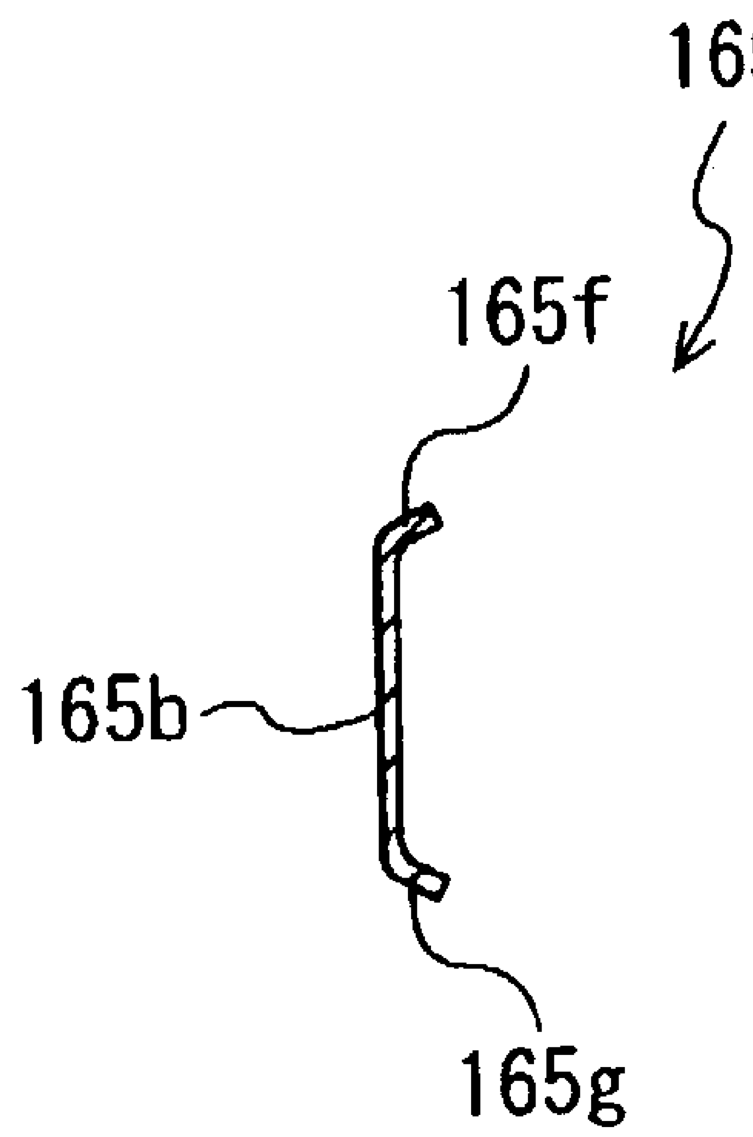


FIG.20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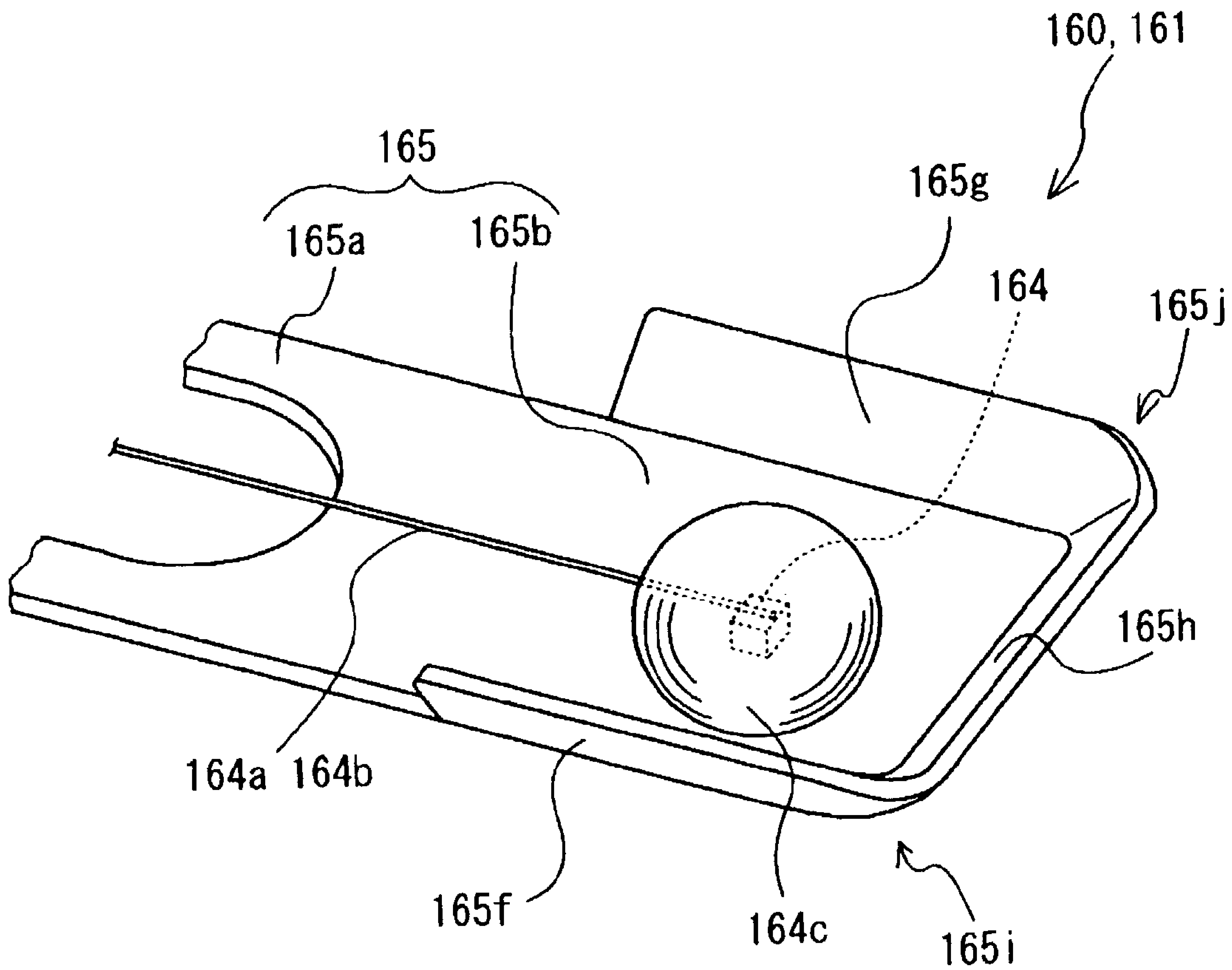
165f
165b
165g

FIG.21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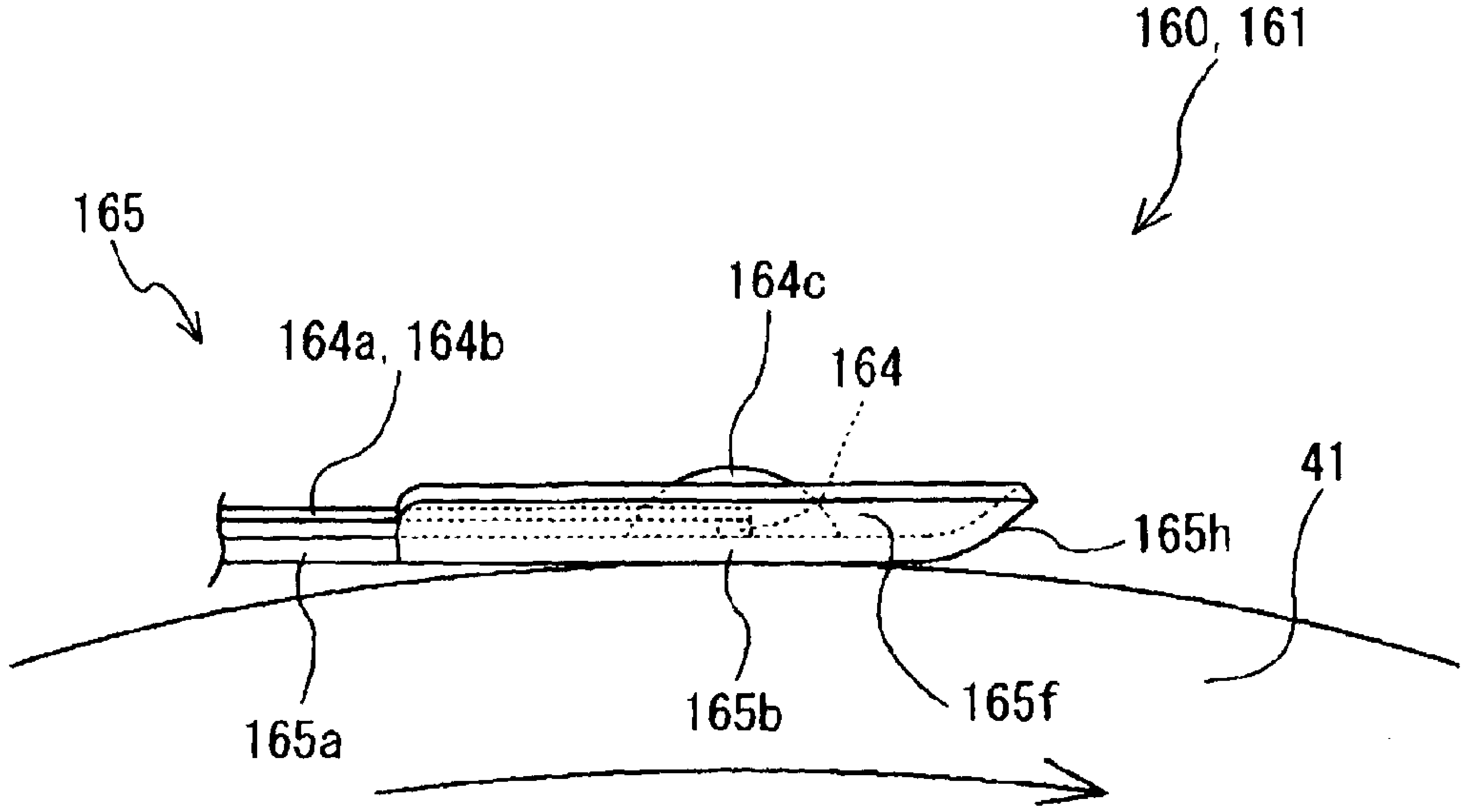
165g
164
165j
165h
164a 164b
165f
164c
165i

FIG.22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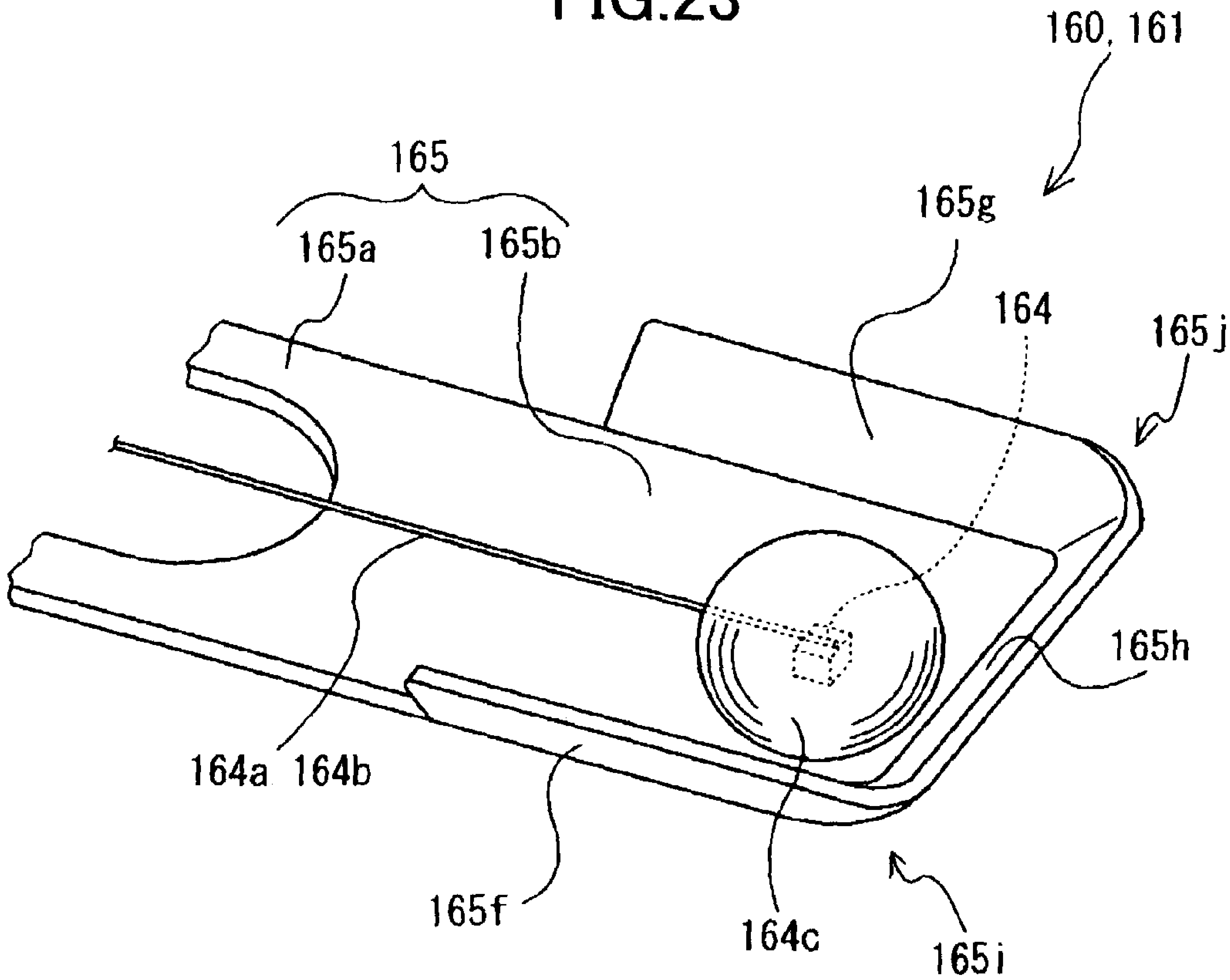
165h
165a
165b
165f

FIG.23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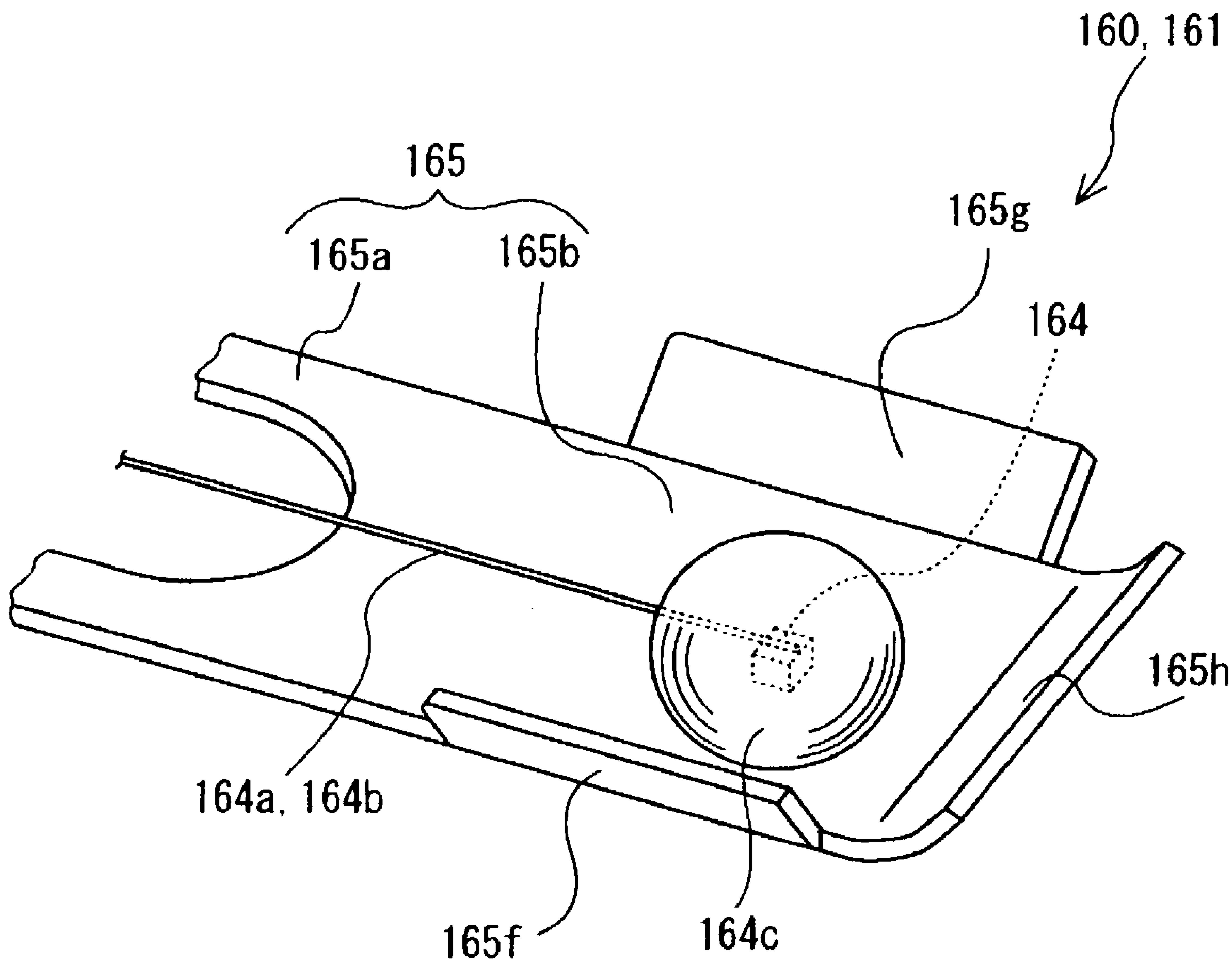
165j
165h
164a 164b
165f
164c
165i

FIG.24



TEMPERATURE SENSOR, HEAT FIXING DEVICE, AND IMAGE FORMING DEVICE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a temperature sensor for detecting the surface temperature of a heating roller of a thermal fixing device in an image forming device, such as a printer, copying machine, facsimile machine, and a multi-function device.

2. Description of the Related Art

Image forming devices, such as printers, copying machines, facsimile machines, and multifunction devices include a thermal fixing device for fixing images onto the surface of a recording medium such as a paper sheet. The thermal fixing device includes a heating roller with a built-in halogen lamp or other heating source. A temperature sensor having a temperature detecting element is disposed in contact with the outer surface of the heating roller in order to detect and control the temperature of the heating roller.

FIG. **1** shows an example of a temperature sensor **260** used in a conventional thermal fixing device. The temperature sensor **260** includes a contact plate **265** and a temperature detecting element **264**. The contact plate **265** is substantially rectangular in shape. The temperature detecting element **264** is fixed by adhesive **264***c* to the upper surface of the contact plate **265** near one lengthwise end of the contact plate **265**. Plate-shaped side edges **265***f* and **265***g* are disposed one on each widthwise edge of the contact plate **265**. The side edges **265***f* and **265***g* form an obtuse angle with upper surface of the contact plate **265** on which the temperature detecting element **264** is fixed.

As shown in FIG. **2**, the temperature sensor **260** is supported in contact with a heating roller **241** of the thermal fixing device. The heating roller **241** rotates from left to right in FIG. **2** as indicated by an arrow. Although not shown in the drawings, the temperature sensor **260** is fixed to a frame of the thermal fixing device. The temperature sensor **260** is oriented with the fixed end located upstream, and the free end located downstream, with respect to the rotation direction of the heating roller **241**. The lower surface of the contact plate **265**, that is, the opposite that on which the temperature detecting element **264** is fixed, contacts the heating roller **241**.

SUMMARY OF THE INVENTION

Toner liquefied by heat in the fixing process may cling to the heating roller **241** and be transported to the contact plate **265** by rotation of the heating roller **241**. This liquefied toner may cling to the contact plate **265** at the position where the contact plate **265** contacts the heating roller **241**. If liquefied toner repeatedly moves onto the contact plate **265**, the corner edge between a tip **265***k* and the lower surface of the contact plate **265** activates build up of the toner on a tip **265***k* of the contact plate **265**. The toner gradually builds up, forming a clump of toner on the tip **265***k*. After growing to a certain size, this clump of toner drops from the tip **265***k* onto the surface of the heating roller **241** and appears in the image being fixed on the recording medium as a spot or distortion in the image.

It is an object of the present invention to provide a temperature sensor, thermal fixing device, and image forming device capable of preventing a clump of foreign matter from accumulating on the contact plate of the temperature sensor.

In order to achieve the above-described object, a temperature sensor according to the present invention includes a support member and a temperature detecting element. The temperature sensor is attached to an attachment member and used in contact with an object.

The support member includes an attachment section, a contact section, and a bend. The attachment section and the bend are on opposite ends of the contact section. The attachment section is for attaching to the attachment member. The contact section has an upper surface and a lower surface that are opposite surfaces of the contact section and that are separated from each other in a direction from the lower surface to the upper surface of the contact section. The lower surface of the contact section is for contacting the object. The bend has a lower surface that slants away from the lower surface of the contact section in the direction from the lower surface to the upper surface of the contact section.

The temperature detecting element is for detecting the temperature of the object. The temperature detecting element is fixed on the support member.

A heat fixing device according to the present invention is for fixing a medium to another medium and includes an attachment member, a thermal fixing member, and a temperature sensor.

The thermal fixing member generates heat for thermally fixing the medium to the other medium.

The temperature sensor includes a support member and a temperature detecting element.

The support member has an attachment section, a contact section, and a bend. The attachment section and the bend are on opposite ends of the contact section. The contact section has an upper surface and a lower surface that are opposite surfaces of the contact section and that are separated from each other in a direction from the lower surface to the upper surface of the contact section. The attachment section is attached to the attachment member with the lower surface of the contact section in contact with the thermal fixing member. The bend has a lower surface that slants away from the lower surface of the contact section in the direction from the lower surface to the upper surface of the contact section.

The temperature detecting element is for detecting the temperature of the thermal fixing member. The temperature detecting element is fixed on the support member.

An image forming device according to the present invention is for forming a developer image on a recording medium and includes a processing unit and a heat fixing device. The processing unit transfers the developer image onto the recording medium. The heat fixing device is for fixing the developer image on the recording medium.

The heat fixing device includes an attachment member, a thermal fixing member that generates heat for thermally fixing the developer image on the recording medium, and a temperature sensor. The temperature sensor has a support member and a temperature detecting element.

The support member has an attachment section, a contact section, and a bend. The attachment section and the bend are on opposite ends of the contact section. The contact section has an upper surface and a lower surface that are opposite surfaces of the contact section and that are separated from each other in a direction from the lower surface to the upper surface of the contact section. The attachment section is attached to the attachment member with the lower surface of the contact section in contact with the thermal fixing member. The bend has a lower surface that slants away from the lower surface of the contact section in the direction from the lower surface to the upper surface of the contact section.

The temperature detecting element is for detecting the temperature of the thermal fixing member. The temperature detecting element is fixed on the support member.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and advantages of the invention will become more apparent from reading the following description of the embodiment taken in connection with the accompanying drawings in which:

FIG. **1** is an enlarged perspective view showing an end portion of a conventional temperature sensor;

FIG. **2** is an enlarged side view showing the contact area between the end portion of the conventional temperature sensor and a heating roller;

FIG. **3** is a center cross-sectional view of a laser printer according to the embodiment;

FIG. **4** is a side cross-sectional view of an image forming section in the laser printer;

FIG. **5** is a front view of a fixing device in the image forming section;

FIG. **6** is a plan view of the fixing device;

FIG. **7** is a back view of the fixing device;

FIG. **8** is a bottom view of the fixing device;

FIG. **9** is a right side view of the fixing device;

FIG. **10** is a left side view of the fixing device;

FIG. **11** is a cross-sectional view of the fixing device taken along the dotted line XI—XI in FIG. **6** in the direction indicated by the arrows;

FIG. **12** is a cross-sectional view of the fixing device taken along the dotted line XII—XII in FIG. **6** in the direction indicated by the arrows;

FIG. **13** is a cross-sectional view of the fixing device taken along the dotted line XIII—XIII in FIG. **6** in the direction indicated by the arrows;

FIG. **14** is a cross-sectional view of the fixing device taken along the dotted line XIV—XIV in FIG. **6** in the direction indicated by the arrows;

FIG. **15** is a plan view of a temperature sensor in the fixing device;

FIG. **16** is a plan view of a contact plate in the temperature sensor;

FIG. **17** is a bottom view of the contact plate;

FIG. **18** is a side view of the contact plate in the direction indicated by an arrow E in FIG. **16**;

FIG. **19** is a side view of the contact plate in the direction indicated by an arrow F in FIG. **16**;

FIG. **20** is a cross-sectional view of the contact plate taken along the dotted line XX—XX in FIG. **16** in the direction indicated by the arrows;

FIG. **21** is an enlarged perspective view showing the end portion of the temperature sensor;

FIG. **22** is an enlarged side view showing the contact area between the end portion of the temperature sensor and a heating roller in the fixing device;

FIG. **23** is an enlarged perspective view showing a variation of the end portion of the temperature sensor of the embodiment; and

FIG. **24** is an enlarged perspective view showing another variation of the end portion of the temperature sensor of the embodiment.

DETAILED DESCRIPTION OF THE EMBODIMENT

A laser printer **1** according to an embodiment of the present invention will be described with reference to the accompanying drawings. First, overall structure of the laser printer **1** will be described with reference to FIG. **3**. FIG. **3** is a central sectional view of the laser printer **1**. As shown in FIG. **3**, the laser printer **1** includes a feeder section **4** and an image forming section **5**. The feeder section **4** is for feeding a sheet **3**. The image forming section **5** is for forming a predetermined image on the fed sheet **3** in a main body case **2**. Note that the left side of FIG. **3** is the front surface of the laser printer **1**.

A sheet delivery tray **46** is formed in a recessed shape and located to a rear upper surface of the main case body **2**. Printed sheets **3** are discharged from the laser printer **1** into a stack on the tray **46**. A cartridge receiving section **57** in which a process cartridge **17** is inserted is provided in a portion close to the front upper surface of the main body case **2**. The cartridge receiving section **57** opens upward. An upper surface cover **54** that pivots vertically around a shaft **54**a is provided on a front end side of the sheet delivery tray **46**. The cover **54** is for covering the cartridge receiving section **57**. Note that the open position of the upper surface cover **54** is indicated by an alternate long and two short dash lines in FIG. **3**.

A sheet delivery path **44** is provided at the rear part in the main body case **2** (right side in FIG. **3**). The sheet delivery path **44** is formed in a semi-arc shape that extends vertically along the back of the main body case **2**. The sheet delivery path **44** delivers the sheet **3** from a fixing device **18** of the image forming section **5**, which is provided on a rear end side in a lower part of the main body case **2**, to the sheet delivery tray **46**. A sheet delivery roller **45** for conveying the sheet **3** is provided along the sheet delivery path **44**. Note that face down sheet delivery can be performed because the sheet delivery path **44** is formed in a semi-arc shape. In face down delivery, the sheet **3** having an image printed on its upper surface is delivered onto the sheet delivery tray **46** with the printed surface facing downward. Because the sheets **3** are stacked in the order of delivery with a printed surface facing downward, a plurality of sheets **3** that are printed in succession can be arranged in the order of printing when images are formed on a plurality of sheets.

The feeder section **4** includes a sheet feed roller **8**, a sheet feed tray **6**, a sheet pressing plate **7**, a separation pad **9**, paper powder removing rollers **10**, conveying rollers **11**, and registration rollers **12**. The sheet feed roller **8** is provided in a bottom part of the main body case **2** at a position above one end of the sheet feed tray **6**. The sheet feed tray **6** is detachably mounted. The sheet pressing plate **7** is provided in the sheet feed tray **6**. The sheets **3** are stacked on the sheet pressing plate **7**. The sheet pressing plate **7** presses the sheets **3** into contact with the sheet feed roller **8**. The separation pad **9** is pressed toward the sheet feed roller **8**, nips and conveys the sheets **3** in cooperation with the sheet feed roller **8** at the time of sheet feed, and prevents double feed of the sheets **3**. The conveying rollers **11** are provided downstream from the sheet feed roller **8** with respect to a conveying direction of the sheets **3**. The conveying rollers **11** perform conveyance of the sheets **3**. The paper powder removing rollers **10** come into contact with the respective conveying rollers **11** with the sheet **3** therebetween to remove paper powder and also convey the sheets **3** in cooperation with the conveying rollers **11**. The registration rollers **12** are provided downstream from the conveying rollers **11** with respect to the conveying direction of the sheets **3** and adjust timing for delivering the sheets **3** at the time of printing.

The sheets **3** are stacked on the sheet pressing plate **7**. A shaft **7***a* is supported by the bottom surface of the sheet feed tray **6** at the end of the sheet pressing plate **7** that is farthest from the sheet feed roller **8**. The shaft **7***a* enables the end of the sheet pressing plate **7** that is closest to the sheet feed roller **8** to pivot vertically with the shaft **7***a* as a pivotal center. The sheet pressing plate **7** is biased toward the sheet feed roller **8** by a not-shown spring from its under surface. Thus, the sheet pressing plate **7** pivots downward against the biasing force of the spring by an amount proportional to the stacked quantity of sheets **3**. The sheet feed roller **8** and the separation pad **9** are disposed in confrontation with each other and the separation pad **9** is pressed toward the sheet feed roller **8** by a spring **13** disposed on the back of the separation pad **9**.

The feeder section **4** further includes a hand supply tray **14**, a hand supply roller **15**, and a separation pad **25**. The hand supply tray **14** includes a tray portion **14***b* and a cover portion **14***c*. The tray portion **14***b* is provided in the front part of the main body case **2**, that is, the left side of FIG. **3**. The tray portion **14***b* is opened and closed in front and back directions, that is, the left and right directions in FIG. **3**, with a shaft **14***a* as a fulcrum. The sheets **3** can be stacked on the tray portion **14***b* when the tray portion **14***b* is open. The cover portion **14***c* slides with respect to the tray section **14***b* and forms a part of the main body case **2** when the tray section **14***b* is closed. The hand supply roller **15** is for feeding the sheets **3** to be stacked on the tray section **14***b* of the hand supply tray **14**. The separation pad **25** is for preventing double feed of the sheets **3**.

The hand supply roller **15** and the separation pad **25** are disposed opposed to each other. The separation pad **25** is pressed toward the hand supply roller **15** by a spring (not shown) disposed on the back of the separation pad **25**. At the time of printing, the sheets **3** stacked on the hand supply tray **14** are delivered by frictional force from the rotating hand supply roller **15** and prevented from being doubly fed by the separation pad **25**, thereby being conveyed to the registration rollers **12** one by one.

A low-voltage power source **90** and a high-voltage power source **95** are provided between the image forming section **5** and sheet feed tray **6**. The low-voltage power source **90** is disposed beneath a scanner unit **16** described later and the fixing device **18**. The high-voltage power source **95** is disposed beneath the process cartridge **17**. The high-voltage power source **95** generates a high-voltage bias that is applied to components in the process cartridge **17** to be described later. Although not shown in the drawings, a high-voltage power source circuit board is disposed in the high-voltage power source **95**. The low-voltage power source **90** converts a single-phase 100-Volt power from a source external to the laser printer **1** into a voltage of 24 Volts for supply to components within the laser printer **1**. Although not shown in the drawings, the low-voltage power source **90** includes a low-voltage power source circuit board for converting voltage in this manner. The low-voltage power source circuit board is disposed in the bottom section of the low-voltage power source **90**. A steel plate open on the left and right encloses the low-voltage power source **90** to protect the circuit board.

A power source fan **120** is provided to the right of the low-voltage power source **90** on the portion of the main frame that is nearest the viewer of FIG. **3**. The power source fan **120** is for introducing external air to cool the low-voltage power source **90**, which generates a large amount of heat. Similarly, a main fan **117** is provided in the main frame on the far side from the viewer of FIG. **3**, to the left of the low-voltage power source **90** for exhausting primarily air around the low-voltage power source **90** out of the laser printer **1**. An ozone fan **108***b* and a sub fan **118** are also provided in the left side of the main frame, that is, at the far side of the printer **1** as viewed in FIG. **3**.

Next, configuration of the image forming section **5** will be described with reference to FIGS. **4** to **6** and **9**. FIG. **4** is a sectional view of the image forming section **5** viewed from a side thereof. FIG. **5** is perspective view of the image forming section **5** disassembled into main components. FIG. **6** is a side view of the process cartridge **17**. FIG. **9** is a view showing the perimeter of a shutter **103** viewed from an insertion port of the process cartridge **17**. As shown in FIGS. **4** and **5**, the image forming section **5** includes a scanner unit **16**, the process cartridge **17**, the fixing device **18**, and a duct **100**. The image forming section **5** is for forming an image on the sheet **3** conveyed by the feeder section **4**.

The scanner unit **16** includes a laser beam emitting section (not shown), a polygon mirror **19**, a heat sink **130**, a fθ lens **20**, a reflecting mirror **21**, and a relay lens **22**. The laser beam emitting section is located below the sheet delivery tray **46** in the upper part of the main body case **2** and irradiates a laser beam. The polygon mirror **19** rotates to scan the laser beam from the laser beam emitting section in a main scanning direction across the surface of a photosensitive drum **27**. The heat sink **130** is for radiating heat generated by the polygon mirror **19**. The fθ lens **20** is for stabilizing scanning speed of the laser beam reflected from the polygon mirror **19**. The reflecting mirror **21** is for reflecting the laser beam. The relay lens **22** is for adjusting the focal position in order to focus the laser beam from the reflecting mirror **21** onto the photosensitive drum **27**. With this configuration, the laser beam is irradiated from the laser beam emitting section based upon predetermined image data and passes through or is reflected by the polygon mirror **19**, the fθ lens **20**, the reflecting mirror **21**, and the relay lens **22** in this order as indicated by an alternate long and dash lines A to expose and scan the surface of the photosensitive drum **27** of the process cartridge **17**.

The process cartridge **17** includes a drum cartridge **23** and a developing cartridge **24** that is detachably mounted on the drum cartridge **23**. The drum cartridge **23** includes the photosensitive drum **27**, a Scorotron charger **29**, a transfer roller **30**, a cleaning roller **51**, a secondary roller **52**, and the like. The developing cartridge **24** includes a developing roller **31**, a supply roller **33**, a toner box **34**, and the like.

The photosensitive drum **27** is arranged beside and in contact with the developing roller **31**. The photosensitive drum **27** is oriented with its rotational axis aligned parallel with the rotational axis of the developing roller **31**. The photosensitive drum **27** is rotatable counterclockwise as indicated by the arrow in FIG. **4**. The photosensitive drum **27** includes a conductive base material and layers formed on the conductive base material. The layers include a charge generation layer and a charge transfer layer. The charge generation layer includes a binder resin in which an organic photoelectric conductor, such as azo pigments or phthalocyanine pigments, is dispersed as a charge generation material. The charge transfer layer is resin such as polycarbonate mixed with a compound such as a hydrazone compound or an arylamine compound. When the photosensitive drum **27** is exposed by a laser beam, the charge generation layer absorbs the light and generates a charge. The charge is transferred onto the surface of the photosensitive drum **27** through the charge transfer layer and counteracts the surface potential charged by the Scorotron charger **29**. As a result, a potential difference is generated between regions of the photosensitive drum **27** that were exposed and regions that were not exposed by the laser light. By selectively exposing and scanning the surface of the photosensitive drum **27** with a laser beam based upon image data, an electrostatic latent image is formed on the photosensitive drum **27**.

The Scorotron charger **29** is disposed above the photosensitive drum **27**. The Scorotron charger **29** is separated from and out of contact with the photosensitive drum **27** by a predetermined distance. The Scorotron charger **29** generates a corona discharge from a wire made from tungsten, for example, and is for positively charging the surface of the photosensitive drum **27** to a uniform charge of positive polarity. The Scorotron charger **29** is turned ON/OFF by a charging power supply. Further, an opening **171** that communicates with the outside air is provided on the upper surface of the housing of the process cartridge **17** at a position near where the Scorotron charger **29** is provided. Ozone and other products generated during charging are discharged to the outside of the process cartridge **17** through the opening **171**.

The developing roller **31** is disposed further downstream than the Scorotron charger **29** with respect to the rotation direction of the photosensitive drum **27**, that is the counterclockwise direction as viewed in FIG. **4**. The developing roller **31** is rotatable clockwise as indicated by an arrow in FIG. **4**. The developing roller **31** includes a roller shaft made from metal coated with a roller made from a conductive rubber material. A development bias is applied to the developing roller **31** from a not-shown development bias application power supply.

The supply roller **33** is disposed beside the developing roller **31** on the opposite side from the photosensitive drum **27** across the developing roller **31**. The supply roller **33** is in pressed contact with the developing roller **31**. The supply roller **33** includes a roller shaft made of metal coated with a roller made of a conductive foam material and is adapted to triboelectrify toner supplied to the developing roller **31**.

The toner box **34** is provided beside the supply roller **33**. The inside of the toner box **34** is filled with toner to be supplied to the developing roller **31** by the supply roller **33**. In this embodiment, non-magnetic, single-component toner with a positive charging nature is used as a developer. The toner is a polymeric toner obtained by copolymerizing polymeric monomers using a well-known polymerization method such as suspending polymerization. Examples polymeric monomers include styrene monomers and acrylic monomers. Styrene is an example of a styrene monomer. Examples of acrylic monomers include acrylic acid, alkyl (C1 to C4) acrylate, and alkyl (C1 to C4) methacrylate. A coloring agent such as carbon black, wax, and the like are mixed in the polymeric toner. An externally added agent such as silica is also added in order to improve fluidity. A particle diameter of the polymeric toner is approximately 6 to 10 μm.

An agitator **36** is supported by a rotation shaft **35** provided in the center of the toner box **34**. The toner in the toner box **34** is agitated by counterclockwise rotation of the agitator **36** as indicated by an arrow in FIG. **4**. A window **38** for determining the amount of remaining toner is provided in a sidewall of the toner box **34**. A cleaner **39** supported on the rotation shaft **35** cleans the window **38**.

The transfer roller **30** is disposed below the photosensitive drum **27** and downstream from the developing roller **31** with respect to the rotating direction of the photosensitive drum **27**. The transfer roller **30** is rotatable clockwise as indicated by an arrow in FIG. **4**. The transfer roller **30** includes a metal roller shaft coated with a roller made from an ion-conductive rubber material. During the transfer process, a transfer bias circuit unit (not shown) of the high-voltage power source **95** applies a transfer forward bias to the transfer roller **30**. The transfer forward bias generates a potential difference between the surfaces of the photosensitive drum **27** and the transfer roller **30**. The potential difference electrically attracts toner that electrostatically clings to the surface of the photosensitive drum **27** to the surface of the transfer roller **30**.

The cleaning roller **51** is arranged beside the photosensitive drum **27** at a position downstream from the transfer roller **30** and upstream from the Scorotron charger **29** with respect to the rotating direction of photosensitive drum **27**. The secondary roller **52** is located on the opposite side of the cleaning roller **51** than the photosensitive drum **27** and is contact with the cleaning roller **51**. A slide contact member **53** is in abutment with the secondary roller **52**. A cleaning bias circuit (not shown) of the high-voltage power source **95** applies a bias to the cleaning roller **51** and the secondary roller **52**.

The photosensitive drum **27** is cleaned using the "cleanerless method." That is, after toner is transferred onto the sheet **3** from the photosensitive drum **27** by the transfer roller **30**, the cleaning roller **51** electrically attracts any residual toner and paper powder that remains on the surface of the photosensitive drum **27**. Then, only the paper powder is electrically attracted by the secondary roller **52** from the cleaning roller **51** and the paper powder attracted by the secondary roller **52** is caught by the slide contact member **53**. At this time, the bias is switched so that the toner on the surface of the cleaning roller **51** returns to the photosensitive drum **27** and, by rotation of the photosensitive drum **27**, to the developing roller **31**. The developing roller **31** returns the toner to the developing cartridge **24**. When the cleaning bias is switched, a transfer bias circuit (not shown) of the high-voltage power source **95** applies a transfer reverse bias to the transfer roller **30**. Unlike the transfer forward bias, the transfer reverse bias generates a potential difference between the surfaces of the transfer roller **30** and photosensitive drum **27** that transfers toner on the surface of the transfer roller **30** to the surface of the photosensitive drum **27**.

An exposure window **69** is opened in the upper surface of the housing of the process cartridge **17** at a position above the photosensitive drum **27**. The laser beam from the scanner unit **16** passes through the exposure window **69** directly onto the photosensitive drum **27**. The exposure window **69** is located closer to the toner box **34** than is the opening **171** of the Scorotron charger **29** and brings the photosensitive drum **27** into communication with the outside of the process cartridge **17**.

The duct **100** exhausts air sucked by the fans **108*b*** and **117** to the outside of the main body case **2**. The duct **100** is a tubular exhaust passage with a V shape in a side view. The duct **100** extends along the entire length of the process cartridge **17** in a width direction of the process cartridge **17**. The width direction of the process cartridge **17** is the direction perpendicular to the direction in which the process cartridge **17** is inserted into the printer **1**. The inside of the duct **100** is divided into two chambers by a vertically-extending partition wall **100*d*** that extends along the entire length of the duct **100** in the width direction of the process cartridge **17**. One of the chambers is a duct **100*a*** for exhausting a product such as ozone mainly generated by the Scorotron charger **29**. The other chamber is a duct **100*b*** for exhausting air containing heat mainly generated by the fixing device **18**.

When the process cartridge **17** is inserted in the main body case **2**, the space above the housing of the process cartridge **17** and in the vicinity of the opening **171** is partitioned into an exhaust chamber **101** by the shutter **103**, a wall surface of the lower part of the duct **100***a*, a partitioning member **104** composed of an elastic member such as rubber or sponge, a left side surface and a right side surface which are left and right side surfaces of the cartridge receiving section **57**. The exhaust chamber **101** is filled with ozone generated by the Scorotron charger **29**. An opening part **105** is formed in the lower surface of the duct **100***a* that faces the Scorotron charger **29**. Air containing the ozone is sucked from the exhaust chamber **101**, through the opening part **105**, and exhausted to the duct **100***a*.

Note that the partitioning member **104** is provided on the lower surface of the duct **100***a* where the end of the process cartridge **17** abuts when the process cartridge **17** is inserted. The partitioning member **104** extends in the width direction of the process cartridge **17** across the entire length of the duct **100**. The partitioning member **104** also functions as a cushioning material for absorbing shock when the process cartridge **17** is inserted.

As shown in FIG. **4**, the shutter **103** is a plate-shaped member elongated in the width direction of the process cartridge **17**. The shutter **103** has a length that is substantially the same as the width of the process cartridge **17**. Shafts **103***a* are provided at one short-wise edge of the shutter **103** and supported by supporting portions **100***c* on the lower surface of the duct **100***a*. The shutter **103** is oriented with the shafts **103***a* facing downstream and a free end side facing upstream with respect to the inserting direction of the process cartridge **17**. The supporting portions **100***c* support the shutter **103** such that the free end side thereof is movable vertically. When the shutter **103** is closed, the free end pivots into contact with the process cartridge **17** at a position between the opening **171** of the Scorotron charger **29** and the exposure window **69**. Further, the shutter **103** moves in association with opening and closing of the upper surface cover **54** by a not-shown link mechanism, whereby the shutter **103** is opened and closed.

As shown in FIGS. **4** and **5**, an opening part **106** is also provided on the lower surface of the duct **100***b*. An exhaust chamber **102** is defined by the front wall, with respect to the inserting direction, of the inserted process cartridge **17**, the lower surface of the duct **100***b*, the fixing device **18**, and a charge removing plate **107**. Air in the exhaust chamber **102** is exhausted from the opening part **106**. Note that the charge removing plate **107** is provided between the process cartridge **17** and the fixing device **18** on the conveying path of the sheet **3** so as to remove charges from sheets **3** that are charged as the sheets **3** pass through the process cartridge **17** during printing. The charge removing plate **107** functions as a sheet guide and is shaped with a plurality of grooves that extend in the conveying direction of the sheet **3**.

An opening part **109** is formed in the wall surface of the scanner unit **16** where the heat sink **130** is opposed to the upper surface **61** of the duct **100**. The opening part **109** extends from one side to the other of the partition wall **100***d* and brings the scanner unit **16** into fluid communicate with both the ducts **100***a* and **100***b*. The heat sink **130** is exposed to a gap between the scanner unit **16** and the upper surface **61** of the duct **100** through an exposure port opened in the lower wall of the scanner unit **16**. A sponge **131** is provided to cover the exposed heat sink **130** and isolate the gap part from other spaces. An exhaust chamber **111** is formed in the area surrounded by the sponge **131**.

As shown in FIGS. **4** and **5**, the fixing device **18** is disposed downstream from the process cartridge **17** with respect to the direction of sheet transport. The fixing device **18** includes a heating roller **41**, a pressing roller **42** for pressing the heating roller **41**, and a pair of conveying rollers **43***a* and **43***b*. The conveying rollers **43***a* and **43***b* are provided downstream from the heating roller **41** and the pressing roller **42**. The heating roller **41** includes a metal tube and a halogen lamp for heating inside the metal tube. While the sheet **3** from the process cartridge **17** passes between the heating roller **41** and the pressing roller **42**, the heating roller **41** pressurizes and heats toner that was transferred onto the sheet **3** in the process cartridge **17**, thereby fixing the toner onto the sheet **3**. Afterward, the sheet **3** is transported to the sheet delivery path **44** by the conveying rollers **43***a* and **43***b*.

As shown in FIG. **5**, the fixing device **18** includes a chassis with a substantially rectangular parallelepiped shape that extends left to right. A top frame **150** and a bottom frame **151** formed of heat-resistant resin are fitted together to form the chassis. Elongated openings **149***a*, **149***b* are formed in the front and rear surfaces, respectively, of the chassis where the top frame **150** and bottom frame **151** come together. The elongated opening **149***a* is formed widthwise in the front surface to enable sheets **3** to enter the fixing device **18**. As shown in FIG. **7**, the elongated opening **149***b* is formed in the rear surface and enables sheets **3** to be discharged from the fixing device **18**. As shown in FIG. **13**, the heating roller **41** and the pressing roller **42** are juxtaposed in the chassis with their axes of rotation extending left-to-right.

As shown in FIGS. **5**, **9**, and **10**, protrusions **148** are formed on the front surface of the bottom frame **151** at both ends. When the fixing device **18** is being inserted into the laser printer **1**, the position of the fixing device **18** is determined by inserting the protrusions **148** into fitting holes formed in the main frame (not shown) of the printer **1**. As shown in FIGS. **5** and **7**, screw holes **147***a* and **147***b* are formed in the left and right ends at the bottom of the bottom frame **151** and penetrate through the bottom frame **151** from front-to-back. The fixing device **18** is fixed to the main frame by inserting screws (not shown) into the screw holes **147***a* and **147***b*.

As shown in FIG. **5**, a conveying roller **146** with an axis extending lengthwise in the fixing device **18** is disposed near the opening **149***a* in the front surface side of the bottom frame **151**. The conveying roller **146** functions as a guide for conveying the sheets **3** into the fixing device **18**. As shown in FIG. **7**, a pair of top and bottom conveying rollers **43***a* and **43***b* is provided near the opening **149***b* in the back surface of the bottom frame **151** for guiding the sheets **3** being discharged from the fixing device **18** onto the sheet delivery path **44**. The axes of the conveying rollers **43***a* and **43***b* extend left-to-right in the fixing device **18**. The conveying roller **43***a* is divided into four sections of rubber rollers on a steel shaft. The upper conveying roller **43***b* includes four resinous rollers positioned to contact each of the four rubber rollers in the bottom conveying roller **43***a*.

As shown in FIG. **7**, a gear **141** connected to the shaft of the conveying roller **43***a* is disposed on the right side of the fixing device **18** near the back surface. Gears **142** and **143** are engaged with the gear **141**. Gear teeth provided around the circumference of the heating roller **41** engage with the gear **143**. The conveying roller **43***a* follows rotation of the heating roller **41** when the heating roller **41** is driven to rotate by a driving force transferred from an external source. As shown in FIG. **9**, an L-shaped arm **145** includes two side plates that extend orthogonal to one another and away from a shaft **145***a* about which the L-shaped arm **145** rotates. The rotational axes of the gears **142** and **143** are fixed one after another in one side plate of the L-shaped arm **145** on the far side from the shaft **145***a*. A spring **145***b* is wrapped around the shaft **145***a* for applying an urging force to the L-shaped arm **145**. When the fixing device **18** is not mounted in the laser printer **1**, the urging force of the spring **145***b* rotates the L-shaped arm **145** to pivot the gear **143** away from the heating roller **41** (a counterclockwise rotation in FIG. **7**), thereby separating the gear **142** from the gear **141** of the conveying roller **43***a* and the gear **143** from the gear teeth at the circumference of the heating roller **41**. Hence, the conveying roller **43***a* can be freely rotated when the fixing device **18** is removed from the laser printer **1** for maintenance purposes.

The other side plate L-shaped arm **145** extends orthogonally to an imaginary line that extends between the shaft **145***a* and the gear **142**. A pulley **144***a* is supported on the free end of the other side plate. The pulley **144***a* contacts the main frame when the fixing device **18** is mounted in the laser printer **1**. When the pulley **144***a* contacts the mainframe, the pulley **144***a* pivots downward so that the L-shaped arm **145** rotates in the clockwise direction of FIG. **9**. Accordingly, the gears **142** and **143** engage with the gear **141** of the conveying roller **43***a* and the external gear teeth of the heating roller **41**. Another pulley **144***b* is provided with the shaft **145***a* as its center of rotation. Because the fixing device **18** moves from right to left as viewed in FIG. **9** when inserted into the printer **1**, the pulley **144***b* contacts the main frame before the pulley **144***a* when the fixing device **18** is mounted in the laser printer **1** so that the L-shaped arm **145** rotates smoothly.

Temperature sensors **160** and **161** shown in FIG. **6** are disposed in the fixing device **18** in contact with the periphery of the heating roller **41** in order to measure the surface temperature of the heating roller **41**. As shown in FIGS. **5** and **6**, the temperature sensor **160** is fixed by a screw to a position near the front surface in the top center of the fixing device **18**. As shown in FIG. **6**, the temperature sensor **161** is similarly fixed by a screw to a position on the back surface and in the top left of the fixing device **18**. A more detailed description of the temperature sensors **160** and **161** will be provided below.

As shown in FIGS. **13** and **14**, the top frame **150** and bottom frame **151** of the fixing device **18** accommodate the heating roller **41** and pressing roller **42**. The heating roller **41** is formed by coating a hollow aluminum roller with a fluorocarbon resin and sintering the assembly. The shaft of the heating roller **41** is supported on both ends of the top frame **150**. Halogen lamps **41***a* and **41***b* are provided in and extend along the length of the heating roller **41**. A tungsten filament is provided in the center portion of the halogen lamp **41***a* to primarily heat the center of the heating roller **41**. Tungsten filaments are provided on both ends of the halogen lamp **41***b* in order that the halogen lamp **41***b* primarily heats the left and right ends of the heating roller **41**. The entire heating roller **41** is evenly heated when a voltage is applied to both the halogen lamps **41***a* and **41***b*. By disposing the halogen lamps **41***a* and **41***b* having different heating positions in the heating roller **41**, it is possible to maintain an even temperature across the heating roller **41** while increasing the rate at which the temperature of the heating roller **41** rises.

The pressing roller **42** includes a silicon rubber shaft having low hardness that is covered by a tube formed of a fluorocarbon resin. As shown in FIGS. **11** and **12**, a support shaft **42***b* and a ball bearing **42***a* are provided on both ends of the pressing roller **42**, enabling the pressing roller **42** to rotate. The ball bearings **42***a* are supported in shaft support plates **152**. A hook-shaped hook **152***a* protrudes from the edge of the shaft support plate **152** and engages with a support shaft **151***a* protruding from the bottom frame **151** at a position below the heating roller **41**. The shaft support plate **152** can be driven to pivot about the support shaft **151***a* within the imaginary plane occupied by the shaft support plate **152**. An operating portion **152***b* protrudes from the shaft support plate **152** on the opposite side of the hook **152***a*. One end of a spring **153** is attached to the operating portion **152***b*. The other end of the spring **153** is attached to an engaging part **151***b* provided on the back part of the bottom frame **151**. The spring **153** urges the operating portion **152***b* upward. As a result, the portion of the shaft support plate **152** that supports the pressing roller **42** between the hook **152***a* and operating portion **152***b* is urged upward, pressing the pressing roller **42** against the heating roller **41**. A lever **155** is disposed in contact with the operating portion **152***b* of the shaft support plate **152**. The lever **155** rotates in the same plane as the shaft support plate **152** about a shaft **151***c* provided in the bottom frame **151** near the operating portion **152***b*. When a paper jam occurs in the fixing device **18**, for example, the user presses an operating portion **155***a* of the lever **155** upward to force the operating portion **152***b* downward against the resisting force to the spring **153**. Accordingly, the shaft support plate **152** rotates in the clockwise direction in FIG. **11**, separating the pressing roller **42** from the heating roller **41** and enabling the user to remove the paper jammed between the rollers. Further, as shown in FIGS. **13** and **14**, two cleaning rollers **154** are provided along the bottom surface of the bottom frame **151** below the pressing roller **42** in pressing contact with the pressing roller **42**. The cleaning rollers **154** clean the pressing roller **42** while rotating along with the pressing roller **42**.

As shown in FIG. **15**, both of the temperature sensors **160** and **161** have the same shape, so the following explanation will be provided for the temperature sensor **160** only as a representative example. The temperature sensor **160** has an elongated plate shape and includes a contact plate **165**, a base **162**, a temperature detecting element **164**, and lead wires **163**. The contact plate **165** contacts the outer periphery of the heating roller **41** at one end and is fixed to the base **162** at the other. The temperature detecting element **164** is fixed on upper surface of the contact plate **165**. The lead wires **163** are for applying a voltage to the temperature detecting element **164**.

The contact plate **165** is a stainless steel plate having a substantially rectangular plate shape in the plan views of FIGS. **16** and **17**. The contact plate **165** includes a contact section **165***b*, an attachment section **165***c*, a connecting section **165***a*, side edges **165***f*, **165***g*, and **165***h*, and corner sections **165***i*, **165***j*, all connected integrally together. The contact section **165***b* is for contacting the heating roller **41**. The contact section **165***b* and the attachment section **165***c* are provided on opposite ends of the connecting section **165***a*. The connecting section **165***a* connects the contact section **165***b* and the attachment section **165***c* and is formed with a slot-like opening formed lengthwise in the center thereof.

The attachment section **165***c* is formed wider than the contact section **165***b* and is for fixing the contact plate **165** to the base **162**. The attachment section **165***c* is formed with a positioning hole **165***d* and a screw hole **165***e*. The positioning hole **165***d* is for positioning the attachment section **165***c* when fixing the contact plate **165** to the base **162** as shown in FIG. **15**. The screw hole **165***e* is for inserting a screw to fix the base **162** to the top frame **150** as shown in FIGS. **5** and **6**.

The contact section **165***b* includes a lower surface and an upper surface on opposite surfaces thereof. The contact section **165***b* contacts the thermal roller **41** at its lower surface. The lower surface of the contact section **165***b* can be alternatively referred to as the surface forms the outer side of the bent portions of the side edges **165***f*, **165***g*, and **165***h*. The temperature detecting element **164** is attached to the upper surface of the contact section **165***b*. The thickness of the contact section **165***b* is the dimension of the contact section **165***b* from the lower surface to the upper surface. Hereinafter "thickness direction" will be used to refer to the direction from the lower surface to the upper surface of the contact section **165***b*.

The side edge **165***h* is integrally connected to the lengthwise end of the contact section **165***b*. The side edges **165***f*, **165***g* are integrally connected to widthwise sides of the contact section **165***b*. The side edges **165***f*, **165***g*, and **165***h* slant upward away from the lower surface of the contact section **165***b* in the thickness direction of the contact section **165***b*, that is, toward the viewer in FIG. **16**. The edge at the free end of each of the side edges **165***f*, **165***g*, and **165***h* follows parallel to corresponding edge of the contact section **165***b*. The corner section **165***i* connects the side edge **165***f* and side edge **165***h* together and the corner section **165***j* connects the side edge **165***g* and side edge **165***h* together. With this configuration, the side edge **165***f*, the corner section **165***i*, the side edge **165***h*, the corner section **165***j*, and the side edge **165***g* form a continuous wall that wraps around the contact section **165***b* on all sides but the side that is integrally connected to the connecting section **165***a*. The lower surface of the continuous wall forms an acute angle with the lower surface of the contact section **165***b*. The acute angle is approximately 45 degrees in the preferred embodiment as can be seen in FIGS. **18** to **20**, for example.

Regions of the contact plate **165** where the side edges **165***f*, **165***g*, and **165***h* connect to the contact section **165***b* are curved at the outer surface of these regions. As a result, the contact plate **165** only contacts the heating roller **41** with smooth, curved surfaces, so that the contact plate **165** will not damage the heating roller **41**. Further, the outer surfaces of the corner sections **165***i* and **165***j* are formed as spherical surfaces. As a result, surfaces at which the side edges **165***f*, **165***g*, and **165***h* meet are connected smoothly. Also, because the corner sections **165***i* and **165***j* connect the side edges **165***f*, **165***g*, and **165***h* integrally together, there are no places where toner can accumulate and form a clump.

The contact plate **165** is formed so that the upper edge of the continuous wall configured by the side edges **165***f*, **165***g*, and **165***h* and the corner sections **165***i* and **165***j* is separated, in the thickness direction, from the portion of the lower surface that contacts the heating roller **41** by a distance that is two times or greater than the thickness of the contact section **165***b*. The contact plate **165** is coated with a corrosion-resistant coating such as fluorocarbon resin on the lower surface from the contact section **165***b* to a portion of the connecting section **165***a*, in order to form a smooth surface.

As shown in FIGS. **15** and **21**, the temperature detecting element **164** is fixed to the center of the upper surface of the contact section **165***b*. The temperature detecting element **164** is a multilayer chip-type temperature sensor formed from a semiconductor ceramic substrate interposed between two terminals. The semiconductor ceramic substrate is made from a metal oxide of iron, manganese, cobalt, or nickel for example. The resistance value in the temperature detecting element **164** decreases logarithmically with increase in temperature. The temperature detecting element **164** is insulated from the surroundings and fixed to the surface of the contact section **165***b* by an adhesive **164***c*. The two terminals of the temperature detecting element **164** are connected to conducting wires **164***a* and **164***b*.

The base **162** is shown in FIG. **15**. The base **162** is formed in a cubic shape from resin covering the attachment section **165***c* of the contact plate **165**. A screw hole **162***a* is formed in the base **162** for fixing the base **162** to the main frame (not shown). The screw hole **162***a* penetrates through the base **162** in the thickness direction at a position aligned with the screw hole **165***e* of the attachment section **165***c*. The two lead wires **163** are fixed at one end to the base **162** at either side of the screw hole **162***a* and at the other end to a connector **163***a*. One of the lead wires **163** is connected to the conducting wire **164***a*, which is connected to the temperature detecting element **164**, and the other lead wires **163** is connected to the conducting wire **164***b*. FIGS. **5** and **6** show the temperature sensors **160** and **161** fixed by screws in the fixing device **18** through the bases **162**. FIGS. **5**, **6**, and **8** show the lead wires **163** running along the outer wall of the top frame **150** and bottom frame **151**. FIG. **7** shows the connector **163***a* engaged in a connector box **151***d* provided in the lower center of the bottom frame **151**.

As shown in FIG. **6**, the temperature sensors **160** and **161** are fixed on the top frame **150**. As shown in FIG. **22**, the temperature sensors **160** and **161** are supported with the contact section **165***b* of the contact plate **165** in contact with the outer surface of the heating roller **41** and are oriented with the connecting section **165***a* upstream from the contact section **165***b* with respect to rotation direction of the heating roller **41** indicated by an arrow in FIG. **22**. Said differently, the surface of the heating roller **41** moves counterclockwise as viewed in FIG. **11**, that is, in the direction from the base **162** to the end of the contact plate **165**.

As mentioned previously, each temperature sensor **160** and **161** contacts the heating roller **41** with the lower surface of the contact section **165***b*. The temperature detecting element **164** is fixed on the upper surface of the contact section **165***b*, that is, on the opposite side of the contact section **165***b* than the side that contacts the heating roller **41**. Therefore, the lower surface of the contact section **165***b*, which contacts the object of detection, can be formed as a smooth surface.

Also, the temperature sensors **160** and **161** are supported with the temperature detecting element **164** aligned at the actual position of contact. Further, the lower surface of the side edge **165***h* curves away from the surface of the heating roller **41** starting from a position that is farther downstream, with respect to the rotating direction of the heating roller **41**, than is the position of contact with the heating roller **41**. As a result, the lower surface of the side edge **165***h* slants upward from the surface of the heating roller **41** so that the edge of the free end of the side edge **165***h* is separated by a prescribed distance from the surface of the heating roller **41**. The prescribed distance is two times the thickness of the contact section **165***b* in the present embodiment. Because the upwardly-curving side edge **165***h* is located downstream with respect to rotation direction of the heating roller **41**, no edge that can lead to the accumulation of toner is located downstream from the contact point between the temperature detection element **164** and the heating roller **41**. Therefore, clumps of toner can be prevented from becoming fixed on the sheets **3**.

Additionally, because the lower surface of the contact plate **165** curves away from the surface of the heating roller **41** from a position that is separated from the contact position between the heating roller **41** and contact plate **165**, it is possible to prevent an abrupt separation between opposing surfaces of the contact plate **165** and the heating roller **41** to enable smooth movement of toner and other foreign matter between these surfaces.

Also, because the areas of the contact plate **165** where the side edges **165*f*, 165*g***, and **165*h*** connect to the contact section **165*b*** and the outer surfaces of the corner section **165*i*** and **165*j*** are formed as curved surfaces, the lower surface of the contact plate **165** is curved from the contact section **165*b*** to the side edge **165*h***, the contact plate **165** has no corner portion that can activate build up of toner.

The temperature sensors **160** and **161** are supported in contact within a "fixing range" in the left-to-right direction of the heating roller **41**. The fixing range of the heating roller **41** is the portion of the fixing device **18** that contacts printed portions of sheets **3** as the sheets **3** pass between the heating roller **41** and the pressing roller **42** and corresponds to the printable region where the process cartridge **17** transfers toner images onto sheets **3** that pass between the photosensitive drum **27** and the transfer roller **30**. The temperature sensor **160** is supported in contact with a surface portion of the heating roller **41** that is heated mainly by the halogen lamp **41*a***. The temperature sensor **161** is supported in contact with a surface portion of the heating roller **41** that is heated mainly by the halogen lamp **41*b***.

Operations of the laser printer **1** during printing will be described with reference to FIGS. **3** and **4**. The sheet **3** located at the top among the sheets stacked on the sheet pressing plate **7** of the sheet feed tray **6** is pressed toward the sheet feed roller **8** by a not-shown spring from the back of the sheet pressing plate **7**. When printing is started, the sheet **3** is fed by frictional force between the sheet **3** and the rotating sheet feed roller **8** to a position between the sheet feed roller **8** and the separation pad **9**. At this point, a plurality of sheets **3** may be doubly fed because of frictional force among the sheets. The separation pad **9** is provided for preventing such double feed. The leading edge of any doubly fed sheets **3** are subjected to a resistance due to a frictional force between the leading edge and the separation pad **9** so that the doubly fed sheets **3** are separated into single sheets. Any paper power that clings to the separated sheets **3** is removed when the single sheet passes by the paper powder removing rollers **10**. The sheets **3** are then conveyed to the registration roller **12** by the conveying rollers **11** opposed to the paper powder removing rollers **10**.

The laser beam emitting section (not shown) of the scanner unit **16** generates a laser beam based upon a laser drive signal generated by an engine controller (not shown). The laser beam falls incident on the polygon mirror **19**. The polygon mirror **19** provides the laser beam with a scan movement in a main scanning direction (direction perpendicular to the conveying direction of the sheet **3**) while reflecting the laser beam toward the fθ lens **20**. The fθ lens **20** converts the laser beam to a constant angular speed. Then, the reflecting mirror **21** reflects the laser beam toward the lens **22**, which converges the laser beam to focus on the surface of the photosensitive drum **27**.

The Scorotron charger **29** charges the surface of the photosensitive drum **27** to, for example, a surface potential of approximately 1000 V. The laser beam from the scanner unit **16** scans across the surface of the photosensitive drum **27** in the main scan direction. The laser beam selectively exposes and does not expose the surface of the photosensitive drum **27** based on the laser drive signal described above. That is, portions of the surface of the photosensitive drum **27** that are to be developed are exposed by the laser light and portions that are not to be developed are not exposed. The surface potential of the photosensitive drum **27** decreases to, for example, approximately 100V at exposed portions, also referred to as bright parts. Because the photosensitive drum **27** rotates counterclockwise as indicated by an arrow in FIG. **4** at this time, the laser beam also exposes the photosensitive drum **27** in an auxiliary scanning direction, which is also the conveying direction of the sheet **3**. As a result of the two scanning actions, an electrical invisible image, that is, an electrostatic latent image is formed on the surface of the photosensitive drum **27** from exposed areas and unexposed areas, which are also referred to as dark parts.

The toner in the toner box **34** is supplied to the developing roller **31** according to the rotation of the supply roller **33**. At this point, the toner is frictionally charged positively between the supply roller **33** and the developing roller **31** and is further regulated to a layer with constant thickness on the developing roller **31**. A positive bias of, for example, approximately 300 to 400 V is applied to the developing roller **31**. The toner, which is carried on the developing roller **31** and charged positively, is transferred to the electrostatic latent image formed on the surface of the photosensitive drum **27** when the toner comes into contact with the photosensitive drum **27**. That is, because the potential of the developing roller **31** is lower than the potential of the dark parts (+1000 V) and higher than the potential of the bright parts, the positively-charged toner moves selectively to the bright parts where the potential is lower. In this way, a visible image of toner is formed on the surface of the photosensitive drum **27** and development is performed.

The registration rollers **12** perform a registration operation on the sheet **3** to deliver the sheet **3** so that the front edge of the visible image formed on the surface of the rotating photosensitive drum **27** and the leading edge of the sheet **3** coincide with each other. A negative bias is applied to the transfer roller **30** while the sheet **3** passes between the photosensitive drum **27** and the transfer roller **30**. The negative bias is approximately −200 V in the present embodiment. Because the negative bias that is applied to the transfer roller **30** is lower than the potential of the bright part (+100 V), the toner electrostatically adhered to the surface of the photosensitive drum **27** moves toward the transfer roller **30**. However, the toner is blocked by the sheet **3** and cannot transfer to the transfer roller **30**. As a result, the toner is transferred onto the sheet **3**. That is, the visible image formed on the surface of the photosensitive drum **27** is transferred onto the sheet **3**.

Then, the sheet **3** having the toner transferred thereon is conveyed to the fixing device **18**. Residual charges of the toner and the sheet **3** are removed by the grounded charge removing plate **107** when the sheet **3** passes by. Then, the heating roller **41** of the fixing device **18** applies heat of approximately 200 degrees, and the pressing roller **42** applies a pressure, to the sheet **3** with the toner image to fix the toner image permanently on the sheet **3**. Note that the heating roller **41** and the pressing roller **42** are each grounded through diodes so that the surface potential of the pressing roller **42** is lower than the surface potential of the heating roller **41**. Accordingly, the positively charged toner that clings to the heating roller **41** side of the sheet **3** is electrically attracted to the lower surface potential of the pressing roller **42**. Therefore, the potential problem of the toner image being distorted because the toner is attracted to the heating roller **41** at the time of fixing is prevented.

The sheet **3** with the fixed toner image is conveyed on the sheet delivery path **44** by the sheet delivery roller **45** and is delivered to the sheet delivery tray **46** with a toner image side facing downward. Similarly, the sheet **3** to be printed next is stacked over the earlier delivered sheet **3** with a printed surface facing downward in the delivery tray **46**. In this way, a user can obtain the sheets **3** aligned in the order of printing.

The operation of the smooth curved surface at the freed end of the temperature sensors **160** and **161** will be described with reference to FIG. **22**. As shown in FIG. **22**, the surface of the heating roller **41** moves in the direction from the connecting section **165***a* to the contact section **165***b* of the temperature sensors **160** and **161** during a printing process. As mentioned previously, the heating roller **41** applies heat to melt and liquefy the toner that clings to the surface of the sheet **3**. Although most of the liquefied toner remains on the surface of the sheet **3** to cool and form the permanent toner image, a small amount of liquefied toner can cling to the surface of the heating roller **41**. Rotation of the heating roller **41** moves such toner through the contact position between the heating roller **41** and contact plate **165**. At this time, the liquefied toner on the surface of the heating roller **41** can cling to the lower surface of the contact plate **165**. However, the residual toner is transferred back to the surface of the heating roller **41** and subsequently to the pressing roller **42** before the liquefied toner can accumulate on the lower surface of the contact plate **165** to any great extent. This is because the surface of the contact plate **165** from the contact section **165***b* to the side edge **165***h* is a smooth curved surface without an edge portion or corner that can trigger the growth of a clump of toner. Once the toner is transferred to the pressing roller **42**, the cleaning rollers **154** clean the toner from the pressing roller **42**.

The temperature detecting element **164** measures the surface temperature of the heating roller **41** through the contact plate **165**. As described above, the resistance value in the temperature detecting element **164** varies according to temperature. Hence, the surface of the heating roller **41** can be maintained at a temperature optimal for printing by adjusting the voltage applied to the halogen lamps **41***a* and **41**b based on the value of the current flowing through the temperature detecting element **164**.

As described above, the side edges **165***f*, **165***g*, and **165***h* bend away from the surface of the heating roller **41** where they connect with the contact section **165***b*. As a result, the outer surfaces where the side edges **165***f*, **165***g*, and **165***h* connect with the contact section **165***b* are curved. Accordingly, no sharp edges or corner portions that can lead to the accumulation of toner are present on the contact section **165***b*. Hence, even if toner that clings to the surface of the heating roller **41** is transferred to the contact plate **165**, the toner will move back to the lower surface of the heating roller **41** before accumulating on the lower surface of the contact plate **165**.

The temperature detecting element **164** is fixed at approximately the center of the contact section **165***b*. Also, the free edge of the contact plate **165** is separated from the lower surface of the contact plate **165**, that is, in the thickness direction of the contact plate **165**, by a distance that is two times or greater the thickness of the contact plate **165**. Hence, because the contact plate **165** is supported to contact the heating roller **41** at a position that corresponds to the temperature detecting element **164**, the surface temperature of the heating roller **41** can be reliably detected using the temperature detecting element **164**. Also, the free edge of the contact plate **165** is separated by a sufficient distance in the thickness direction from the surface of the heating roller **41**. Edges of the contact plate **165** that can cause accumulation of foreign matter are sufficiently separated from the heating roller **41** so that toner or other foreign matter remaining on the surface of the heating roller **41** will not accumulate on these edges of the contact plate **165** and form a clump.

While the invention has been described in detail with reference to specific embodiments thereof, it would be apparent to those skilled in the art that many modifications and variations may be made therein without departing from the spirit of the invention, the scope of which is defined by the attached claims.

For example, the embodiment describes the temperature detecting element **164** as being fixed at the center of the contact section **165***b*. However, as shown in FIG. **23**, the temperature detecting element **164** can be fixed at a position nearer the side edge **165***h*.

Further, the embodiment describes the wall surrounding the periphery of the contact section **165***b* as being continuous because of the corner sections **165***i*, **165***j*. However, as shown in FIG. **24**, the wall surrounding the periphery of the contact section **165***b* need only include the side edges **165***f*, **165***g*, and **165***h*.

Still further, the embodiment describes the continuous wall forming an acute angle of 45 degrees with respect to the imaginary plane defined by the lower surface of the contact section **165***b*. However, the acute angle of inclination formed by the side edges **165***f*, **165***g*, and **165***h* in relation to the plane of the contact section **165***b* may be set optionally to any angle in a range greater than 0 and less than 90 degrees. Because the angle of inclination of the side edges **165***f*, **165***g*, and **165***h* is an acute angle, there will be not areas that can lead to the accumulation of toner or other foreign matter.

What is claimed is:

1. A heat fixing device for fixing a medium to another medium, the heat fixing device comprising:
- an attachment member;
- a thermal fixing member that generates heat for thermally fixing the medium to the other medium; and
- a temperature sensor including:
  - a substantially rigid support member having an attachment section, a contact section, and a bend, the attachment section and the bend being on opposite ends of the contact section, the contact section having an upper surface and a lower surface that are opposite surfaces of the contact section and that are separated from each other in a direction from the lower surface to the upper surface of the contact section, the attachment section being attached to the attachment member with the lower surface of the contact section in contact with the thermal fixing member, the bend having a lower surface that slants away from the lower surface of the contact section in the direction from the lower surface to the upper surface of the contact section, the lower surface of the bend and the lower surface of the contact section forming a rounded corner portion; and
  - a temperature detecting element for detecting the temperature of the thermal fixing member, the temperature detecting element being fixed on the support member.

2. The heat fixing device as claimed in claim **1**, wherein the fixing member has an outer surface that contacts the lower surface of the contact section, the fixing member being rotatable to move the outer surface in a direction from the attachment section to the contact section of the temperature sensor at a position where the outer surface of the fixing member contacts the lower surface of the contact section.

3. The heat fixing device as claimed in claim 2, wherein the lower surface of the contact section is substantially flat and the lower surface of the contact section contacts the fixing member at a position separated from the bend by a predetermined distance in the direction from the attachment section to the contact section of the temperature sensor.

4. The heat fixing device as claimed in claim 1, wherein the fixing member is a heating roller and the temperature detecting element of the temperature sensor is fixed on the upper surface of the support member at a position corresponding to where the bottom surface of the contact section contacts the heating roller.

5. An image forming device for forming a developer image on a recording medium, the image forming device comprising:

a processing unit that transfers the developer image onto the recording medium; and

a heat fixing device for fixing the developer image on the recording medium, the heat fixing device including:

an attachment member;

a thermal fixing member that generates heat for thermally fixing the developer image on the recording medium; and

a temperature sensor including:

a substantially rigid support member having an attachment section, a contact section, and a bend, the attachment section and the bend being on opposite ends of the contact section, the contact section having an upper surface and a lower surface that are opposite surfaces of the contact section and that are separated from each other in a direction from the lower surface to the upper surface of the contact section, the attachment section being attached to the attachment member with the lower surface of the contact section in contact with the thermal fixing member, the bend having a lower surface that slants away from the lower surface of the contact section in the direction from the lower surface to the upper surface of the contact section, the lower surface of the bend and the lower surface of the contact section forming a rounded corner portion; and

a temperature detecting element for detecting the temperature of the thermal fixing member, the temperature detecting element being fixed on the support member.

6. The image forming device as claimed in claim 5, wherein the fixing member is elongated in an axial direction, the processing unit transferring the developer image onto the recording medium and the fixing member fixing the developer image onto the recording medium within a predetermined range in the axial direction, the temperature sensor contacting the fixing member within the predetermined range in the axial direction.

7. A temperature sensor that is attached to an attachment member and used in contact with an object, the temperature sensor comprising:

a support member including an attachment section, a contact section, and a bend, the attachment section and the bend being on opposite ends of the contact section, the attachment section being for attaching to the attachment member, the contact section having an upper surface and a lower surface that are opposite surfaces of the contact section and that are separated from each other in a direction from the lower surface to the upper surface of the contact section, the lower surface of the contact section being for contacting the object, the bend having a lower surface that slants away from the lower surface of the contact section in the direction from the lower surface to the upper surface of the contact section; and

a temperature detecting element for detecting the temperature of the object, the temperature detecting element being fixed on the support member,

wherein the upper surface and the lower surface of the contact section are separated by a first distance in the direction from the lower surface to the upper surface of the contact section, the bend further having a connected end and free edge at opposite ends thereof, the connected end being integrally connected to the contact section, the free edge being separated from the lower surface of the contact section in the direction from the lower surface to the upper surface of the contact section by a second distance that is two times or greater than the first distance.

8. The temperature sensor as claimed in claim 7, wherein the lower surface of the bend is continuous with the lower surface of the contact section, the lower surface of the bend slanting away from the lower surface of the contact section in a curve.

9. The temperature sensor as claimed in claim 7, wherein the temperature detecting element is fixed on the upper surface of the contact section of the support member.

10. The temperature sensor as claimed in claim 7, wherein the temperature detection element is separated from the bend by a predetermined distance in a direction from the bend to the attachment section.

11. The temperature sensor as claimed in claim 7, wherein the lower surface of the bend extends at an angle that is greater than 0 degrees and less than 90 degrees with respect to the lower surface of the contact section.

12. The temperature sensor as claimed in claim 7, wherein the contact section further has sides extending substantially in a direction from the contact section to the bend, the support member further including side bends that extend from the sides of the contact section, the side bends each having a lower surface that slants away from the lower surface of the contact section in the direction from the lower surface to the upper surface of the contact section.

13. The temperature sensor as claimed in claim 12, wherein the support member further includes connecting parts that integrally connect the side bends to the bend.

14. The temperature sensor as claimed in claim 13, wherein the connecting parts have outer surfaces that are continuous with the lower surfaces of the side bends, the outer surface of each connecting part being curved.

15. The temperature sensor as claimed in claim 7, wherein the lower surface of the bend and the lower surface of the contact section form a rounded corner portion.

16. A temperature sensor that is attached to an attachment member and used in contact with an object, the temperature sensor comprising:

a support member including an attachment section, a contact section, and a bend, the attachment section and the bend being on opposite ends of the contact section, the attachment section being for attaching to the attachment member, the contact section having an upper surface and a lower surface that are opposite surfaces of the contact section and that are separated from each other in a direction from the lower surface to the upper surface of the contact section, the lower surface of the contact section being for contacting the object, the bend having a lower surface that slants away from the lower surface of the contact section in the direction from the lower surface to the upper surface of the contact section; and

a temperature detecting element for detecting the temperature of the object, the temperature detecting element being fixed on the support member,

wherein the contact section further has sides extending substantially in a direction from the contact section to the bend, the support member further including side bends that extend from the sides of the contact section, the side bends each having a lower surface that slants away from the lower surface of the contact section in the direction from the lower surface to the upper surface of the contact section.

17. The temperature sensor as claimed in claim **16**, wherein the upper surface and the lower surface of the contact section are separated by a first distance in the direction from the lower surface to the upper surface of the contact section, the bend further having a connected end and free edge at opposite ends thereof, the connected end being integrally connected to the contact section, the free edge being separated from the lower surface of the contact section in the direction from the lower surface to the upper surface of the contact section by a second distance that is two times or greater than the first distance.

18. The temperature sensor as claimed in claim **16**, wherein the support member further includes connecting parts that integrally connect the side bends to the bend.

19. The temperature sensor as claimed in claim **18**, wherein the connecting parts have outer surfaces that are continuous with the lower surfaces of the side bends, the outer surface of each connecting part being curved.

20. The temperature sensor as claimed in claim **16**, wherein the lower surface of the bend is continuous with the lower surface of the contact section, the lower surface of the bend slanting away from the lower surface of the contact section in a curve.

21. The temperature sensor as claimed in claim **16**, wherein the temperature detecting element is fixed on the upper surface of the contact section of the support member.

22. The temperature sensor as claimed in claim **16**, wherein the temperature detection element is separated from the bend by a predetermined distance in a direction from the bend to the attachment section.

23. The temperature sensor as claimed in claim **16**, wherein the lower surface of the bend extends at an angle that is greater than 0 degrees and less than 90 degrees with respect to the lower surface of the contact section.

24. The temperature sensor as claimed in claim **16**, wherein the support member further includes connecting parts that integrally connect the side bends that extend from the sides of the contact section of the support member to the bend.

25. The temperature sensor as claimed in claim **24**, wherein the connecting parts have outer surfaces that are continuous with the lower surfaces of the side bends, the outer surface of each connecting part being curved.

26. The temperature sensor as claimed in claim **16**, wherein the lower surface of the bend and the lower surface of the contact section form a rounded corner portion.

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